2017

ECOLOGICAL, MOLECULAR, AND MORPHOLOGICAL DATA: A SYNERGISTIC APPROACH TO RESOLVE SPECIES LIMITS OF *LYTOPYLUS* FROM THE AREA DE CONSERVACIÓN GUANACASTE, COSTA RICA (HYMENOPTERA: BRACONIDAE: AGATHIDINAE)

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Digital Object Identifier: https://doi.org/10.13023/ETD.2017.357

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ECOLOGICAL, MOLECULAR, AND MORPHOLOGICAL DATA: A SYNERGISTIC APPROACH TO RESOLVE SPECIES LIMITS OF *LYTOPYLU*S FROM THE AREA DE CONSERVACIÓN GUANACASTE, COSTA RICA (HYMENOPTERA: BRACONIDAE: AGATHIDINAE)

THESIS

A thesis submitted in partial fulfillment of the
requirements for the degree of Master of Science in the
College of Agriculture, Food and Environment
at the University of Kentucky
By

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2017

ABSTRACT OF THESIS

ECOLOGICAL, MOLECULAR, AND MORPHOLOGICAL DATA: A SYNERGISTIC APPROACH TO RESOLVE SPECIES LIMITS OF *LYTOPYLUS* FROM THE AREA DE CONSERVACIÓN GUANACASTE, COSTA RICA (HYMENOPTERA: BRACONIDAE: AGATHIDINAE)

Lytopylus is species-rich genus of Agathidinae (Hymenoptera: Braconidae: Agathidinae), but limited information of the genus has been published. Morphological, molecular, and ecological data were compared to resolve the species limits of *Lytopylus* reared from caterpillars collected the Area de Conservación Guanacaste (ACG) in Costa Rica. Molecular data were initially used to hypothesize species limits, and morphological and host use data were employed to make a final decision when molecular data was indecisive, e.g., when the genetic difference between species was slight. Thirty-two new species are described with image plates of each species. Phylogenetic analyses of the barcode region of the Cytochrome *c* oxidase subunit I (COI) mitochondrial gene was conducted using Neighbor-Joining (NJ) and the Maximum likelihood (ML) analysis. A concatenated COI+28S dataset was analyzed by ML analysis to elucidate evolutionary patterns in ecological characters.

KEYWORDS: *Lytopylus*, Species limits, Parasitoid wasps, DNA barcoding, Host use, Evolutionary patterns.

_Ilgoo Kang_____

_July. 27. 2017_____

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Chapter 1: ECOLOGICAL, MOLECULAR, AND MORPHOLOGICAL DATA: A SYNERGISTIC APPROACH TO RESOLVE SPECIES LIMITS OF *LYTOPYLUS* FROM THE AREA DE CONSERVACIÓN GUANACASTE, COSTA RICA

1.1 INTRODUCTION

Agathidinae comprises approximately 1,200 described species (Yu et al. 2012), making it a moderately species-diverse subfamily of Braconidae. All members of Agathidinae are koinobiont endoparasitoids of lepidopteran caterpillars (Sharkey, 2006) meaning that they are internal parasitoids that attack early instar host larvae and allow their hosts to continue to develop while the parasite develops. A plethora of agathidine cryptic species remain to be described and named. The genus *Lytopylus* is the relatively species-rich genus among genera of Agathidinae. Over most of its history, *Lytopylus* was considered a junior synonym of *Bassus* Fabricius, *Microdus* Nees, or *Agathis* Latreille. Sharkey et al. (2016) removed the genus from synonymy and synonymized, *Agathellina* Enderlein, 1920, *Ditropia* Enderlein, 1920, and *Austroearinus* Sharkey, 2006, under it, including eight species in all. Only one species of *Lytopylus* has any published host associations: *L. unicoloratus* (Shenefelt, 1970) is a parasitoid of the potato tuber-worm *Phthorimaea operculella* (Zeller, 1873), a member of the Gelechiidae.

This thesis focuses on specimens of *Lytopylus* collected in the Area de Conservación Guanacaste (ACG), north-western Costa Rica, for the past 30 years. Dr. Dan Janzen has been conducting a survey of Lepidoptera and their parasitoids that occur in the ACG, (Janzen et al., 2009; Janzen and Hallwachs 2011). His team of 'gusaneros' (wormers) collect wild caterpillars, photograph them, and rear them until an adult lepidopteran or parasitoid is produced. This results in caterpillars being associated with their adult forms as well as documentation of tri-trophic interactions and food-webs among plants, caterpillars, and their parasitoids. COI mitochondrial barcodes were obtained from the Barcode of Life Datasystem (BoLD) (http://www.boldsystems.org) (Hebert et al., 2003).

All specimens of *Lytopylus* in this work were reared from lepidopteran caterpillars collected in the ACG and all are associated with ecological information including host caterpillar, collection date, eclosion date, caterpillar food plant, and locality.

This work also includes an image plate of each species, a traditional identification key and a digital web-based interactive key; both have illustrations of morphological characters. A diagnosis and description are provided for thirty-two new species and one previously described species. Evolutionary patterns of host use of *Lytopylus* and feeding niche of the lepidopteran host are mapped onto a phylogenetic tree, and evolutionary implications are discussed.

1.2 METHODS

1.2.1 *Species Concepts*

I use Mayr's (1969) biological species concept, i.e., a species consists of a group of natural populations that are reproductively isolated from other groups. Because insect taxonomists usually work with dead specimens, delimitation of insect species is based on methods that indirectly infer reproductive isolation rather than direct observation. Morphological, molecular (COI sequences), and host data were employed to delimit species.

1.2.2 *Specimen Information*

Most specimens, and all holotypes, are deposited in the insect collection in the Biology Department of Utah State University (USA, Utah, Logan). Duplicates are in the Hymenoptera Institute Collection, Entomology Department, University of Kentucky. The detailed parasitoid specimen records are available by search of the individual specimen DHJPARxxxxxxx voucher codes at Daniel Janzen's database (http://janzen.sas.upenn.edu/caterpillars/database.lasso). Host caterpillars are uniquely identified by their own voucher code system, which is recognizable by YY-SRNP-XXXXX where "YY" is the two digit year and "XXXXX" is a unique number within that year. Some of the host caterpillars are incompletely identified, but they also have unique names such as *Dichomeris* Janzen512, which is a putative name for *Dichomeris* species 512 as determined by a biodiversity specialist of the ACG team. These names will be updated in the Daniel Janzen's database when the species is classified with a formal scientific name, but the putative name, in this case *Dichomeris* Janzen512, will remain searchable in that database.

1.2.3 *Morphological Analysis*

Morphological characters were recorded using the DELTA Editor (v. 1.02; Dallwitz et al. 1999). The DELTA Editor was used to enter the data for both interactive (web-based) and traditional printed keys. Images to illustrate the couplets were taken by a JVC digital camera fixed on microscopes and stacked with the program Automontage©. Plates for each species were arranged using Adobe Photoshop Elements 12. The morphological terms mostly follow Sharkey and Wharton (1997) and are coordinated with the Hymenoptera Anatomy Ontology (HAO, Yoder et al. 2010). The minimum number of characters necessary to distinguish a species from all other species is included in a diagnosis for each species. Descriptions, based on the holotype of each species, were automatically generated using DELTA.

1.2.4 *Molecular Methods*

1.2.4.1 DNA extraction, PCR, and Sequencing

270 COI sequences were sourced from the BoLD database. DNA was extracted using a glass fibre protocol (Ivanova et al. 2006). Extracts were resuspended in 30 μL dH2O, and a 658-bp region near the 5' terminus of the CO1 gene was amplified using standard insect primers LepF1 (5'-ATTCAACCAATCATAAAGATATTGG-3') and LepR1 (5'-TAAACTTCTGGATGTCCAAAAAATC A-3') following the established protocols (Smith et al., 2008). If initial amplification were failed, other amplifications were conducted following the established protocols using internal primer pairs, LepF1-C113R (130 bp) or LepF1-C_ANTMR1D (300 bp) and MLepF1-LepR1 (400 bp) to generate shorter overlapping sequences (Smith et al. 2008).

For the specimens which DNA sequences were not available in BoLD, DNA was extracted from individual legs at University of Kentucky (UKY) with Qiagen DNeasy Blood and Tissue Kit following the manufacturer's animal tissue protocol (Qiagen Inc., Chatsworth, California, USA).

COI was amplified from extracted DNA using the forward primer mlCOIintF (Leray et al. 2013) and reverse primer jgHCO2198 (Geller et al. 2013). Unique 9 bp tags, designed using Barcode Generator (available from

http://comailab.genomecenter.ucdavis.edu/index.php/Barcode_generator) were attached to the primers so that each sequence could be traced to its parent specimen by the unique combination of tags. PCR was performed using Takara reagents consisted of 10X buffer, 2.5 μM nucleotides, 1 μM of each primer, 0.125 U Takara Ex Taq, 16.375 μL of ddH2O, and 2 μL template DNA for a total reaction volume of 25 μL. The thermal cycling protocol had an initial denaturation period at 94 °C for 3 min and then to denature at 94 °C for 30 s, anneal initially at 62°C (-1°C per cycle) for 16 cycles for 30 s and 46 °C for 29 cycles for 30 s and extend at 72 °C for 30 s. This was repeated for 45 cycles with a final extension step at 72 °C for 7 min.

In addition, D2-D3 regions of nuclear 28s rDNA were amplified using 28SD2F (Belshaw and Quicke, 1997) and D3R (Harry et al., 1996). PCR for 28S was performed using Qiagen 1X buffer, 4 mM MgSO4, 0.3 mM dNTP, 0.4 μM of each primer, 1.00 U Qiagen Taq, ddH2O, and 1–3 μL template DNA for a total reaction volume of 25 μL. Cycling conditions included an initial denaturation at 94 °C for 3 min and then to denature at 95 °C for 30 s, anneal at 53 °C for 30 s and extend at 72 °C for 70 s for a total of 35 cycles. PCR products were electrophoresed in 1% or 2.5% agarose stained with ethidium bromide to determine reaction success.

28S PCR products comprising the target region were then outsourced for Sanger sequencing by the Advanced Genetic Technologies Center (University of Kentucky, Lexington, KY). Sequence strands were cycle sequenced using labeled dideoxy-nucleotides with ABI 3730, Big-Dye Terminator mix v. 3.0 or with ABI PRISM 3730xl, BigDye Terminator mix v. 3.1 (Applied Biosystems, Foster City, California, USA). COI PCR products were sequenced on an Illumina MiSeq system at the UKY Genomics Core Laboratory.

1.2.4.2 DNA assembly and Phylogenetic analysis

Contigs downloaded from BoLD and produced by Sanger sequences were assembled, and the sequences were edited by using Geneious Pro (v. 6.1.6; Drummond et al. 2010) with the default settings. Edited sequences were stored in the NEXUS file format. Also, three sequences produced by NGS were obtained and included in the file of edited sequences. NGS sequencing data was assembled using PEAR (Zhang et al. 2013) and

demultiplexed using custom Phython scripts. Among all bidirectional reads from each specimen, the 1st and 2nd most numerous reads were manually retrieved from the output file. The sequences were then queried against the GenBank nucleotide library using NCBI BLAST (https://blast.ncbi.nlm.nih.gov/Blast.cgi) and those that were highly similar to *Lytopylus* specimens were retained. Finally, three COI sequences were exported from the FASTQ file and added to the file of edited sequences. The multiple sequence alignment for sequences obtained by both Sanger sequencing and NGS were assembled on the MAFFT server (http://www.ebi.ac.uk/Tools/msa/mafft/; v. 7; Katoh et al., 2013).

An NJ tree (Saitou and Nei, 1987) was constructed by using PAUP* (v. 4.0β10; Swofford, 2003) using the p-distance setting with COI data set. ML analyses were performed using Garli (v. 2.01; Zwickl, 2006) on the COI data set and the concatenated COI+28S data set. The data were partitioned by codon position for COI (three partitions) and codon position and gene region for COI+28S (four partitions). I applied the most complex model available (GTR+I+G; Rodriguez et al., 1990) to each partition as per recommendations of Huelsenbeck and Rannala (2004) for likelihood-based analyses. Garli applies separate parameter estimates to each partition. A 20-replicate ML analysis was performed using default settings for each data set. Additionally, a ML bootstrap analysis (minimum 500 replicates) was conducted to assess nodal support (Garli, default settings). In addition, a BI phylogenetic analysis was run with COI+28S data set with MrBayes (v. 3.2; Ronquist et al. 2012). The data were partitioned by codon positions and gene region. Two BI searches were conducted independently and simultaneously. Four separate Markov chain Monte Carlo (MCMC) runs using unlinked partitions (prset applyto=all; ratepr=variable; unlink pinvar=all; unlink revmat=all; unlink statefreq=all; unlink shape=all; unlink tratio=all) for a total of 25,000,000 generations were performed (sampling every 1,000 generations) to allow each partition to have its own set of parameter estimates. The option “rate multiplier” (prset ratepr = variable) was used to obtain branch lengths as accurate as possible instead of another option (prset ratepr = fixed), which estimates branch length inadequately (Marshall et al. 2006). The average standard deviation of split frequencies was less than 0.02. Initial 50% of trees were discarded and total 12,500 trees post-burn-in trees were used to generate the majority rule consensus tree using PAUP* (v. 4.0β10; Swofford, 2003).

1.2.5 *Host Use*

Biological and ecological data for ACG lepidopteran caterpillars and adults such as collection location, collection and eclosion dates, collectors, food plants, host species, and parasitoid species were accumulated and provided by Dr. Dan Janzen. For a final decision, species-level host data were employed. Detailed biological data are described by Dr. Dan Janzen in the results section. Additionally, the data can be accessed at http://janzen.sas.upenn.edu (Janzen et al. 2009).

1.2.6 *Species Delimitation*

The NJ tree and the tree of highest log-likelihood from 20 ML search reps in Figure 1 and Figure 2 were based solely on COI, and these trees were constructed to assist in the delimitation of species. Molecular species concepts were initially based on the NJ tree with COI data and were compared to the best ML tree with COI data. The 2% genetic distance cut-off which has been a conventional threshold for species delimitation using COI barcodes (Jones et al. 2011) and has been used in the Barcode Index Numbers (BINs) (http://www.barcodinglife.org/ index.php/Public_BarcodeIndexNumber_Home) was used to cluster putative species (Smith et al. 2013). Morphological and host use data were also used to make a final decision. These data were employed under three conditions: 1. When a maximum intraspecific genetic difference among specimens grouped as a species was relatively larger than genetic difference among specimens of other species. 2. When morphological and molecular data were incongruent. 3. When the genetic difference between sister-species was near the 2% cut-off point.

1.2.7 *Character Optimization*

The estimation of the ancestral character states for lepidopteran host families, based on the best ML tree, was attained in Mesquite (v. 3.2; Maddison and Maddison, 2017). Host family data were obtained from Daniel Janzen's database. Four lepidopteran families (Depressariidae, Gelechiidae, Tortricidae, and Oecophoridae) serve as hosts. The Markov k-state one parameter model, which assumes an equal rate of change between all character states (MK1, Lewis, 2001) was used to infer ancestral character states in the ML optimizations. The threshold was set at 2.0, which is the general cutoff point for the

significance of ancestral character state reconstructions. If a character state with log likelihood was higher than 2.0 or more units, the state was considered significantly better than the other states, or, if lower, the state was rejected (Pagel 1999, following Edwards 1972). The threshold has been used by numerous authors (Koepfli et al. 2008; Chapman et al. 2012; Polidori et al. 2013; Hofstetter et al. 2014; Karnkowska et al. 2015; Hood et al. 2015; Moretti et al. 2017). The evolution of feeding niche of host caterpillar was also estimated using these methods.

1.3 RESULTS AND DISCUSSION

1.3.1 *Species Delimitation*

The NJ tree and the highest log-likelihood ML tree with COI data both suggest twenty-eight molecular species, and twenty-eight putative species were clustered using the 2% genetic distance cut-off.

I also produced morphological species concepts as did my advisor, Dr. Sharkey using character states such as sculpture, ovipositor length, and wing patterns and color. Both I.K. and M.J.S. had different morphological species concepts, and these agreed with the final species concepts at rates of 37.9% and 44.8% respectively. Morphological species concepts resulted in all possible types of errors, i.e., clumping, splitting, and both clumping and splitting (mixing the members of two or more species). In contrast to this the molecular species concepts were 96.6% correct. This has dire implications for previous taxonomic treatments of braconids based solely on morphology.

The incongruity between molecular species concepts and final species concepts was caused by *L. sigifredomarini* and *L. guillermopereirai*. The genetic variation between these two species was 0.4%, and the ML tree grouped them together (Figure 2, node A). I, however, delimited them as two species because they are morphologically different, and the NJ tree recovered these species as sister taxa despite small genetic difference. (Figure 1, node A). In addition, they attack different host caterpillars with different feeding niches.

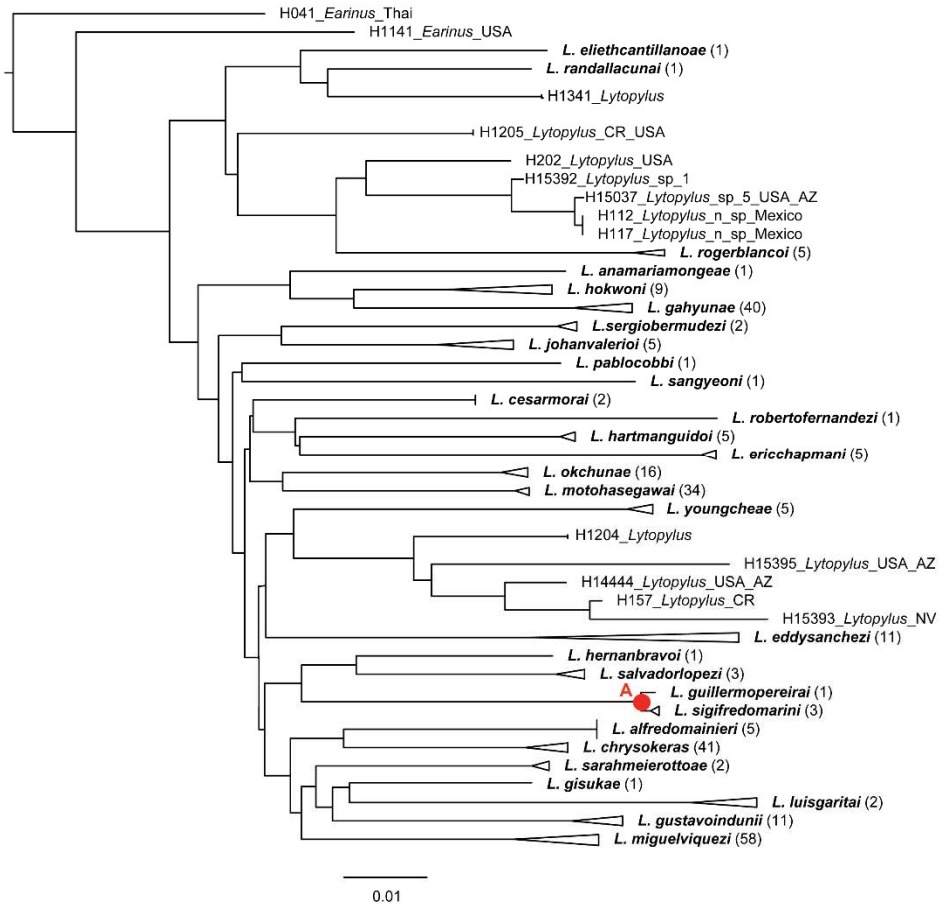


Figure 1. The NJ tree of the COI barcode region for twenty-nine of the thirty-three *Lytopylus* treated here. Triangles represent collapsed clades; their lengths (measured horizontally) represent the distance from the most basal node to the apex of the longest branch. The number of specimens each triangle is given in parentheses following the species name. Nodes labeled red letters are those discussed in the text.

Specimens of *L. miguelviquezi* and *L. motohasegawai*, were recognized as four or five morphospecies (depending on the taxonomist) based on their variable coloration. All of these specimens were clustered into two groups on both the NJ tree and on the ML tree, i.e., four to five morphospecies clumped into two molecular species. Members of *L. motohasegawai*, attack one lepidopteran host species, supporting the hypothesis that they are one species. Because the host use data was congruent with the molecular data, specimens of *L. motohasegawai* were confidently hypothesized as one species based the integration of these two data sources. Members of *L. miguelviquezi*, have broad host range, attacking five species of caterpillars. However, although the specimens differed in

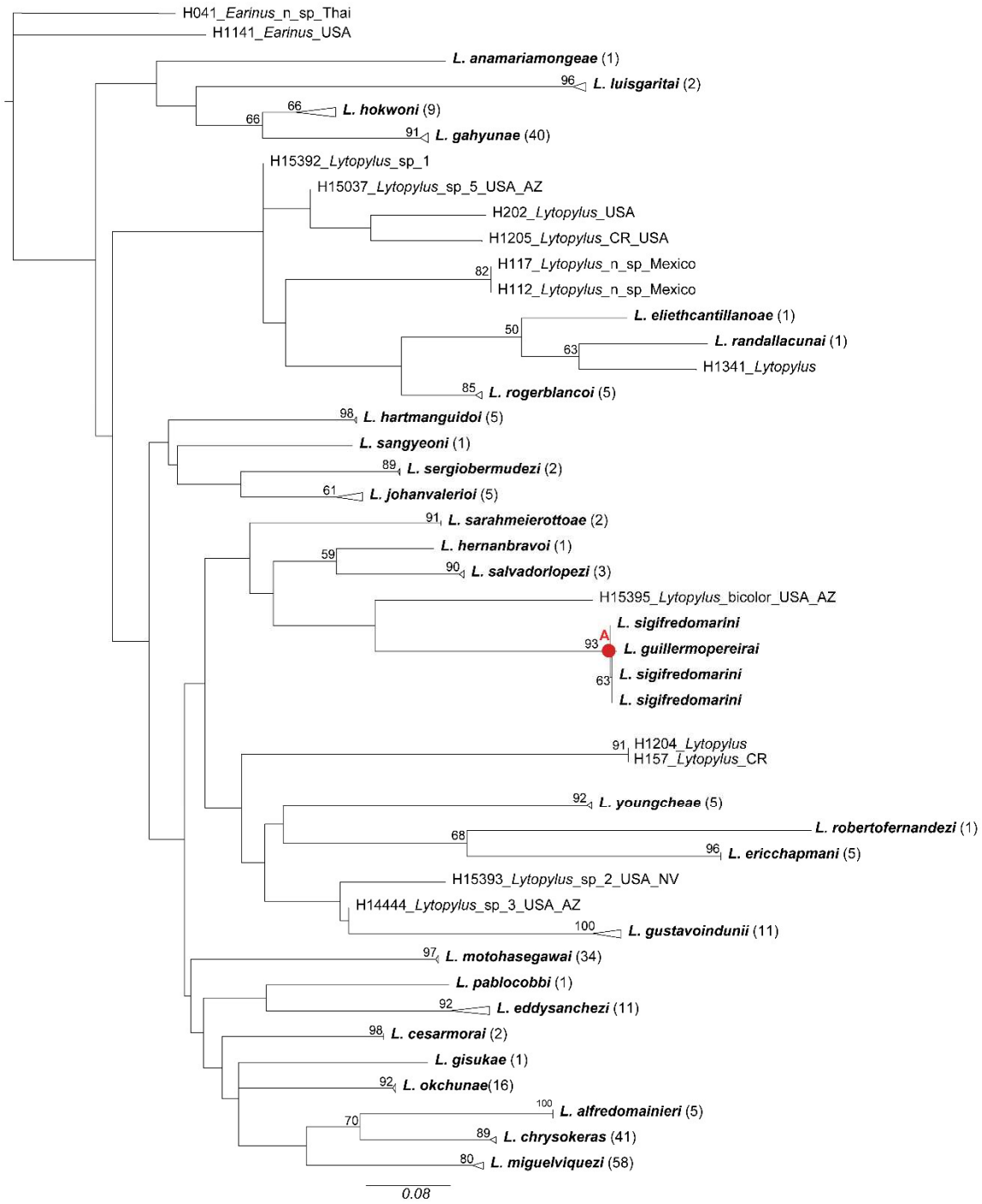


Figure 2. Tree of highest log-likelihood from 20 ML search reps of the COI data set. Terminals with bold-faced type indicate species described herein. ML bootstrap values appear above the branches. Triangles represent collapsed clades; their lengths (measured horizontally) represent the distance from the most basal node to the apex of the longest branch. The number of specimens each triangle is given in parentheses following the species name. Nodes labeled red letters are

those discussed in the text.

host species, they share one host subfamily (Dichomeridini Gelechiidae), and one host feeding niche (all are leaf-tiers). After deciding the species limits of these two species, the morphology of the specimens was reexamined. Interestingly, specimens with black metasomata were all males, and specimens possessing orange metasomata were all females, indicating that sexual dimorphism had confused the initial morphological delimitations.

The four species (*L. alejandromasisi*, *L. ivanniasandovalae*, *L. josecortesi*, *L. mariamartachavarriae*) for which genetic data were not available were delimited using morphology and host used.

1.3.2 *Phylogenetic Considerations*

The highest log-likelihood tree based on the concatenated COI and 28S data (Figure 3) is used here as the best approximation to the phylogenetic relationships among species of *Lytopylus*. Unnecessary terminals on the tree were compressed, however in the supplemental documentation, four uncompressed trees are included, i.e., 20 replicate ML search for the tree of highest log-likelihood; ML bootstrap tree from 500 replicates; the Bayesian tree of highest posterior probability; the Bayesian majority-rule consensus tree. *Earinus* was selected as the outgroup because the genus was shown to be the sister-group of *Lytopylus* (Sharkey and Chapman 2017, in press).

Although many clades have high support values, there are no apparent morphological synapomorphies for any of these, suggesting a high level of convergence and loss in morphological characters.

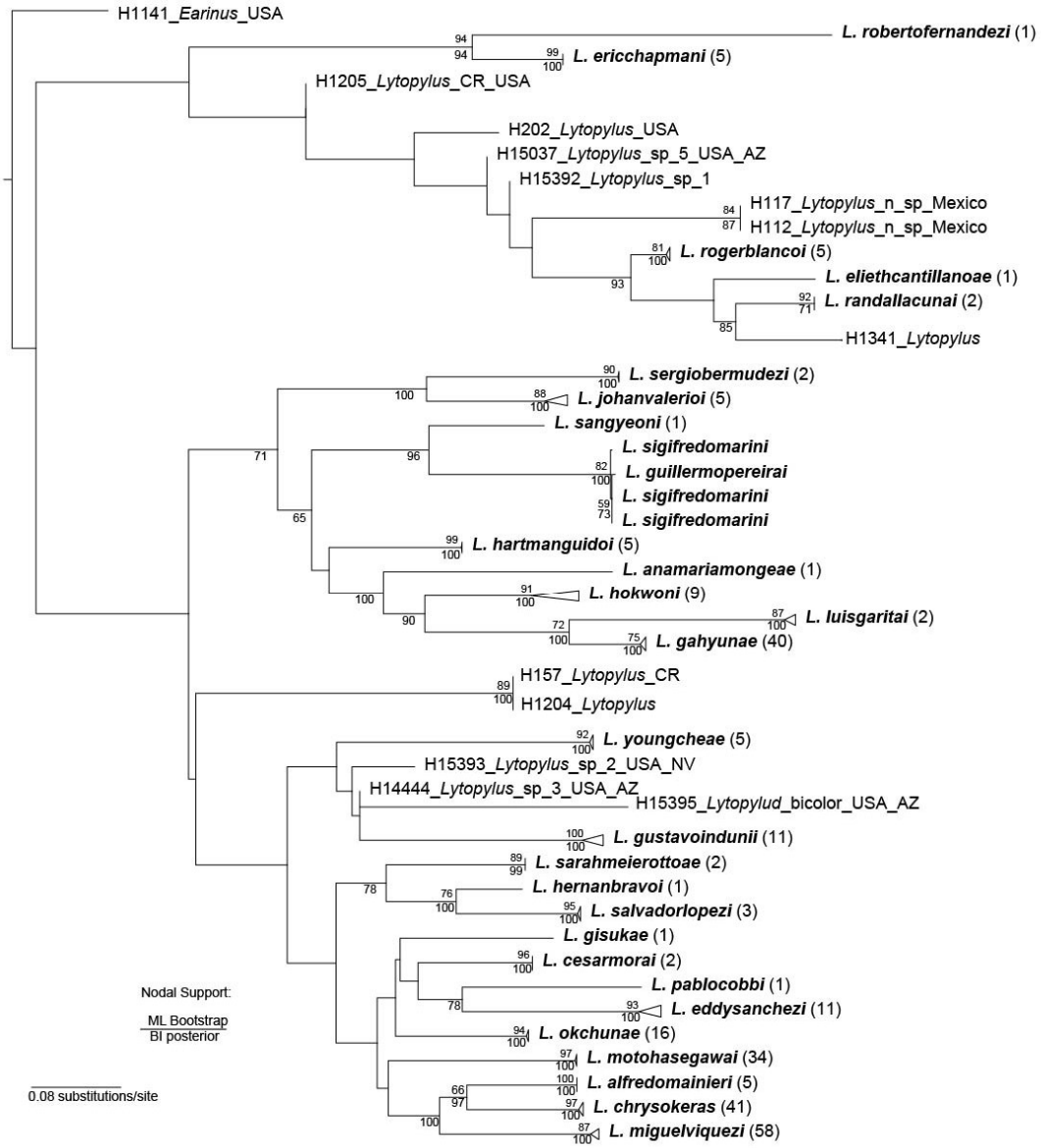


Figure 3. Tree of highest log-likelihood from 20 ML search reps of the combined COI+28S data set. Terminals in bold-faced type indicate species described herein. ML bootstrap values appear above the branches. Triangles represent collapsed clades; their lengths (measured horizontally) represent the distance from the most basal node to the apex of the longest branch. The number of specimens each triangle is given in parentheses following the species name.

1.3.3 *Evolutionary Patterns of Host Family and Feeding Niche of the Host Caterpillars*

Most genera of Agathidinae attack one or a few closely-related families of Lepidoptera (Sharkey et al. 2011); The species of *Lytopylus* revised here attack four families of

Lepidoptera. Three families (Depressariidae, Gelechiidae, and Oecophoridae) are members of Gelechioidea, Totricidae is a family of Tortricoidea, and have caterpillars with concealed habits. Each species studied herein was restricted to one host family of Lepidoptera but some varied in attacking *Antheotrica*, *Cerconota*, *Dichomeris* and *Stenoma* genera in Depressariidae. Ancestral character state optimizations strongly suggest that Depressariidae is the ancestral host family for this assemblage of *Lytopylus* (Figure 4, node 1). Five independent transitions (Figure 4, node 2 - node 6) in host use are implied, as follows. There were at least two independent shifts from Depressariidae to Gelichiidae, and single shifts from Depressariidae to Tortricidae and Oecophoridae. Furthermore, there was a single reversal from Gelichiidae back to Depressariidae in one lineage, *L. rogerblancoi*. Because many nodes have nonsignificant support and some species are singletons, the reconstruction is in need of further testing.

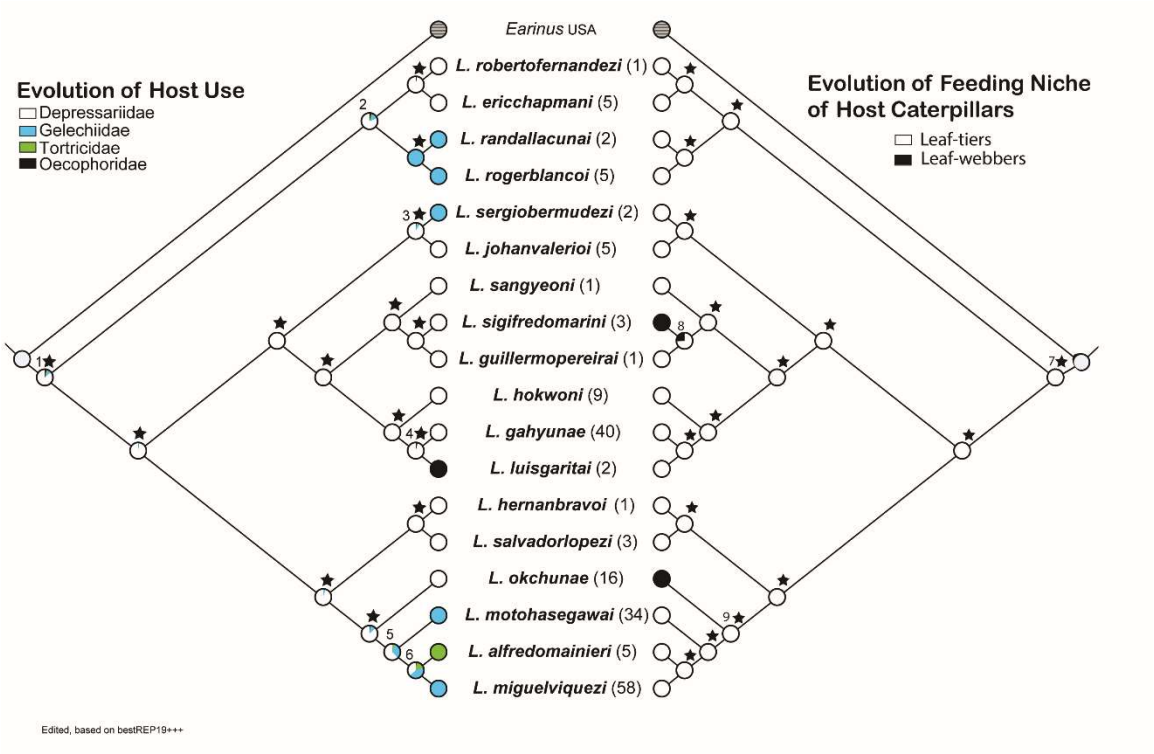


Figure 4. Maximum likelihood optimization of host use and feeding niche of the host caterpillars on the topology from Figure 3 (pruned to include only one terminal per species) and analyzed with Mesquite using the MK1 model of character evolution. Only character states that are statistically significant (ancestral character state estimates with a log-likelihood two or more units higher than all others) are shown in the pie charts at the nodes. A solid (one color) node indicates

that state is significantly better than all other possible states. Grey indicates unknown character states. Numbers after species names are specimen numbers.

Feeding niche of host caterpillar species was also optimized. There were two types of feeding niche among the four host families. Most of the ACG host caterpillars are leaf-tires, folding one or few leaves with silk, but two species are leaf-webbers stacking many leaves together. Ancestral character state optimizations strongly suggest that leaf-tier is the ancestral feeding niche of host caterpillar species for this assemblage of *Lytopylus* (Figure 4, node 7). The shifts from leaf-tier to leaf-webber were independent (Figure 4, node 8&9).

1.3.4 *Systematics*

Lytopylus Föster, 1862

Type species. *Lytopylus azygos* Viereck, 1905, by monotypy, first included species.

Agathellina Enderlein, 1920. Type species: *Agathellina columbiana* Enderlein, 1920.

Ditropia Enderlein, 1920. Type species: *Ditropia strigata* Enderlein, 1920.

Austroearinus Sharkey, 2006. Type species: *Bassus rufofemoratus* Muesebeck, 1927.

Diagnosis. *Lytopylus* can be distinguished from all other agathidine genera with the following combination of characters: tarsal claws simple with a basal lobe; mesoscutum unsculptured and notauli completely absent; fore wing RS+Ma not complete; Cub of hind wing weak or absent and never tubular; hind coxal cavities open; median tergite 3 smooth.

Distribution. Restricted to the New World, from the USA south to Argentina.

Species diversity. Including the thirty-two species described here, there are forty two described species but, based on the diversity in the Hymenoptera Institute Collection, there are hundreds more throughout the New World that await description.

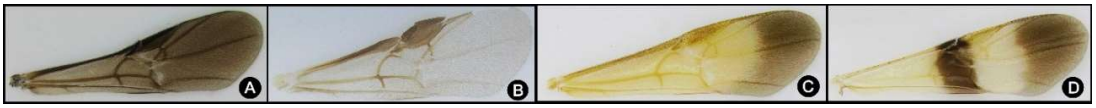
1.3.5 KEY TO THE SPECIES OF *LYTOPYLUS* OF THE AREA DE CONSEVCIÓN GUANACASTE, COSTA RICA

1. A. Fore wing mostly or entirely infuscated……... 2

   B. Fore wing hyaline or with a slight yellow tinge…...……28

   C. Fore wing with one apical black band……. 31

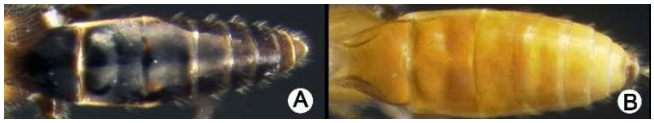
   D. Fore wing with two black bands……. 33



Couplet 1

2(1). A. Median tergites mostly or entirely melanic (brown to black)……3

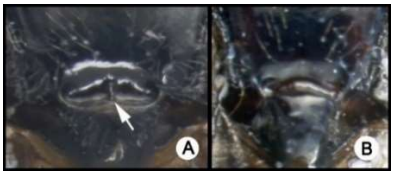
   B. Median tergites entirely pale (yellow to orange) or mostly pale with posterior terga black……. 10



Couplet 2

3(2). A. Scutellar sulcus with at least one longitudinal carina……4

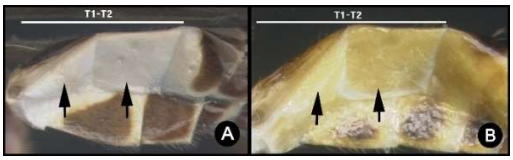
   B. Scutellar sulcus lacking longitudinal carinae…… 6



Couplet 3

4(3). A. Lateral tergites one and two entirely white……. ***L. cesarmorai***

   B. Lateral tergites one and two mostly or entirely yellow……. 5



Couplet 4

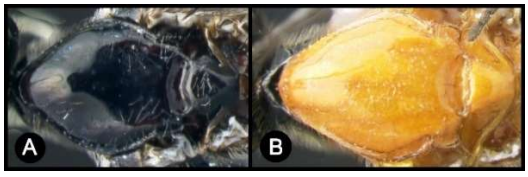
5(4). A. Hind femur mostly pale (yellow to orange) or black and pale with a similar percentage of each color……***L. motohasegawai*** **male**

B. Hind femur mostly black, pale apically…… ***L. miguelviquezi*** **male**

Couplet 5

6(3). A. Mesoscutum mostly or entirely melanic (brown to black) ..... ***L. guillermopereirai***

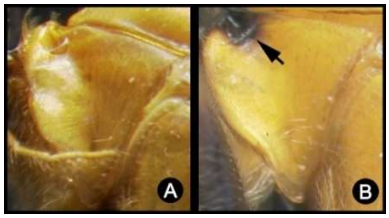
B. Mesoscutum mostly or entirely pale (yellow to orange) …….. 7



Couplet 6

7(6). A. Pronotum entirely pale (yellow to orange) ….……. 8

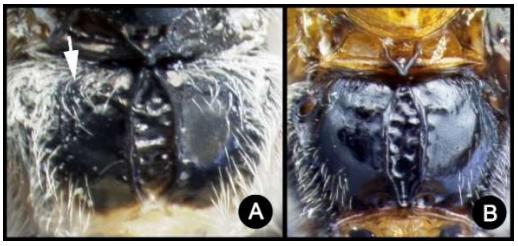
B. Pronotum bicolored……... 9



Couplet 7

8(7). A. Anterior transverse carina of propodeum reaching the lateral margin…….. ……. ***L. sarahmeierottoae***

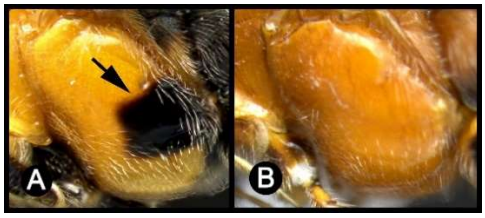
B. Anterior transverse carina of propodeum not reaching the lateral margin or absent…… ***L. salvadorlopezi***



Couplet 8

9(7). A. Mesopleuron bicolored…… ***L. anamariamongeae***

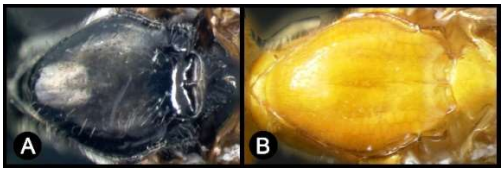
B. Mesopleuron entirely pale (yellow to orange) …… ***L. luisgaritai***



Couplet 9

10(2). A. Mesoscutum mostly or entirely melanic ……..…… 11

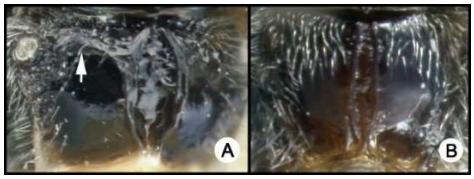
B. Mesoscutum mostly or entirely pale (yellow to orange) …….. 18



Couplet 10

11(10). A. Anterior transverse carina of propodeum reaching the lateral margin…12

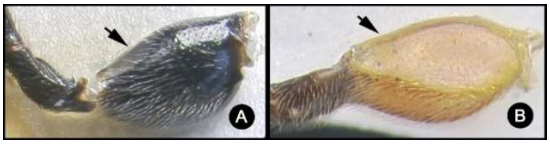
B. Anterior transverse carina of propodeum not reaching the lateral margin or absent…… 15



Couplet 11

12(11). A. Hind coxa entirely black……... ***L. hernanbravoi***

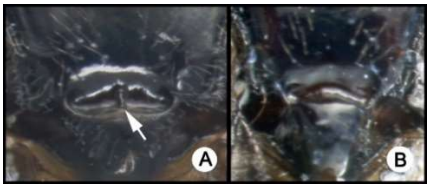
B. Hind coxa mostly or entirely pale……13



Couplet 12

13(12). A. Scutellar sulcus with at least one longitudinal carina……. 14

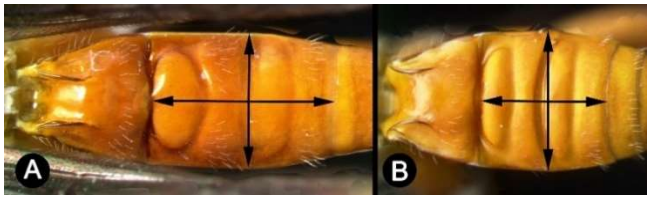
B. Scutellar sulcus lacking longitudinal carinae…… ***L. sigifredomarini***



Couplet 13

14(13). A. Median syntergite 2+3 1.4 times longer than wide…… ***L. gahyunae***

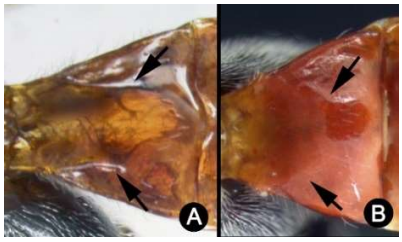
B. Median syntergite 2+3 as long as wide……. ***L. sangyeoni***



Couplet 14

15(11). A. Lateral longitudinal carinae of median tergite 1 sharp…… 16

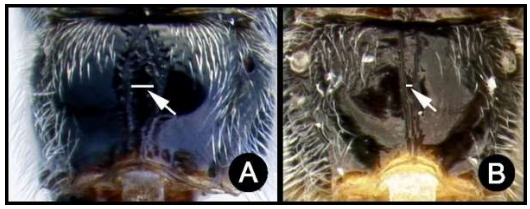
B. Lateral longitudinal carinae of median tergite 1 blunt…… 17



Couplet 15

16(15). A. Median areola relatively wide……***L. josecortesi***

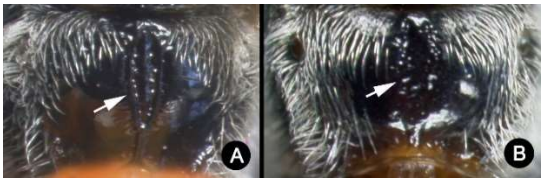
B. Median areola relatively narrow……. ***L.eliethcantillanoae***



Couplet 16

17(15). A. Median areola of propodeum with sharp margins…….. ***L.rogerblancoi***

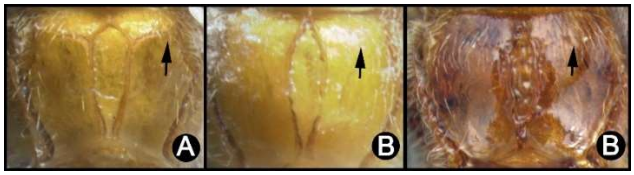
B. Median areola of propodeum lacking sharp margins……***L. randallacunai***



Couplet 17

18(10). A. Anterior transverse carina of propodeum reaching the lateral margin… 19

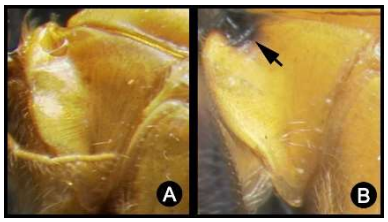
B. Anterior transverse carina of propodeum not reaching the lateral margin or absent……... 21



Couplet 18

19(18). A. Pronotum entirely pale (yellow to orange) …….. 20

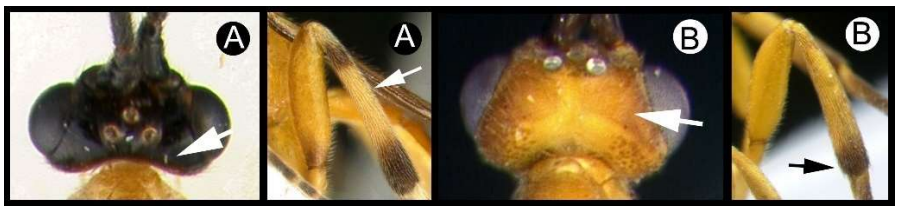
B. Pronotum bicolored……. ***L. johanvalerioi***



Couplet 19

20(19). A. Vertex of head entirely melanic; hind tibia black basally and distally, yellow at mid-length…….. ***L.alejandromasisi***

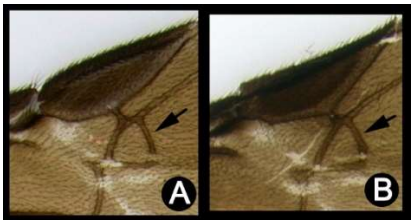
B. Vertex of head mostly or entirely yellow; hind tibia pale basally, black apically…… ***L. chrysokeras***



Couplet 20

21(18). A. Fore wing second submarginal cell quadrate…….. 22

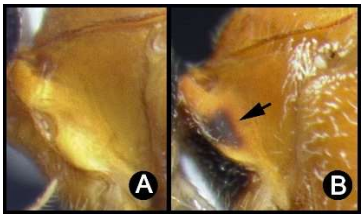
B. Fore wing second submarginal cell triangular…… 24



Couplet 21

22(21). A. Pronotum entirely pale (yellow to orange …….. 23

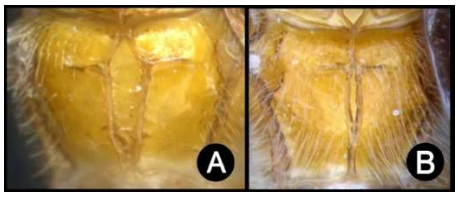
B. Pronotum bicolored…… ***L.pablocobbi***



Couplet 22

23(22). A. Median areola relatively wide; median areola of propodeum kite-shaped…..……. ***L.motohasegawai*** **female**

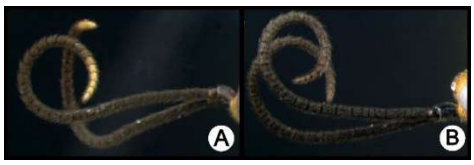
B. Median areola relatively narrow; median areola of propodeum spindle-shaped……. ***L. gisukae***



Couplet 23

24(21). A. Apical flagellomeres usually bright yellow, always distinctly paler than subapical flagellomeres…… ***L. chrysokeras***

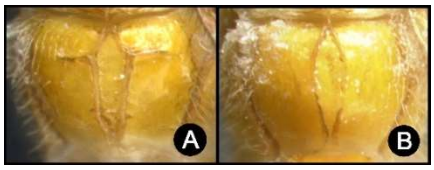
B. Apical flagellomeres brown not distinctly paler than subapical flagellomeres…….. 25



Couplet 24

25(24). A. Median areola of propodeum kite-shaped…… ***L. miguelviquezi*** **female**

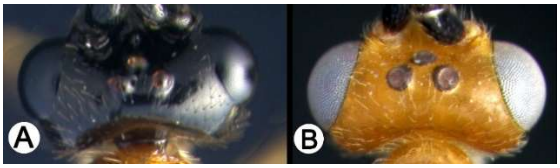
B. Median areola of propodeum spindle-shaped…….. 26



Couplet 25

26(25). A. Vertex of head entirely melanic…….. 27

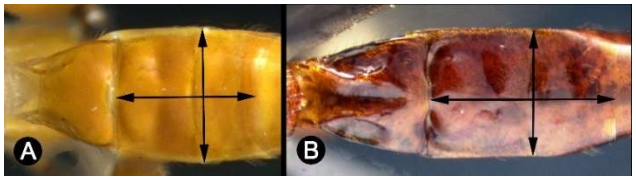
B. Vertex of head mostly or entirely yellow…… ***L.gustavoindunii***



Couplet 26

27(26). A. Median syntergite 2+3 1.1 times longer than wide…... ***L. alfredomainieri***

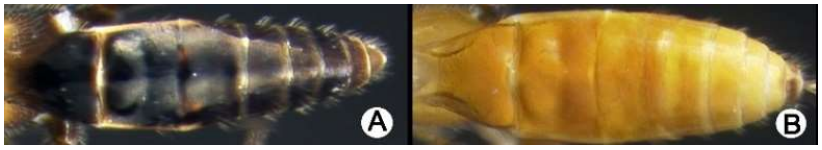
B. Median syntergite 2+3 1.5 times longer than wide……..***L. okchunae***



Couplet 27

28(1). A. Median tergites mostly or entirely melanic (brown to black) ..***L. cesarmorai***

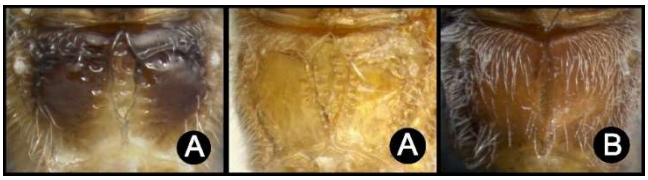
B. Median tergites entirely pale (yellow to orange) or mostly pale with posterior terga black……. 29



Couplet 28

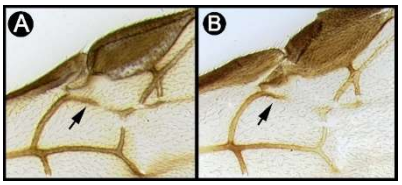
29(28). A. Anterior transverse carinae of propodeum reaching the lateral margin; median areola of propodeum kite-shaped…… 30

B. Anterior transverse carinae of propodeum not reaching the lateral margin or absent; median areola of propodeum spindle-shaped…….…… ***L. ivanniasandovalae***



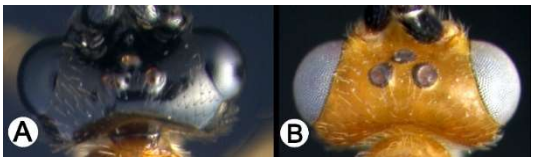
Couplet 29

30(29). A. Fore wing RS+Ma more complete…….. ***L. sergiobermudezi***
B. Fore wing RS+Ma less complete…… ***L. mariamartachavarriae***



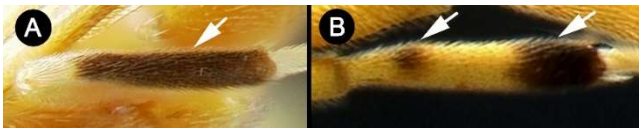
Couplet 30

31(1). A. Vertex of head mostly or entirely melanic…… ***L. youngcheae***
B. Vertex of head mostly or entirely yellow……. 32



Couplet 31

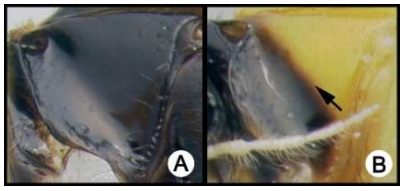
32(31). A. Mid tibia mostly black, yellow basally……. ***L. eddysanchezi***
B. Mid tibia with a sub-basal black patch and black apically, yellow at mid-length and basally…… ***L. hartmanguidoi***



Couplet 32

33(1). A. Pronotum entirely melanic…… 34

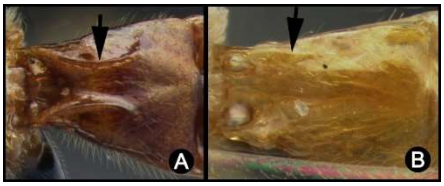
B. Pronotum bicolored…… ***L. ericchapmani***



Couplet 33

34(33). A. Lateral longitudinal carinae of median tergite 1 sharp…….. ***L. hokwoni***

B. Lateral longitudinal carinae of median tergite 1 blunt..... ***L. robertofernandezi***



Couplet 34

1.3.6 Species Descriptions

***Lytopylus alejandromasisi* Kang n. sp.**

Diagnosis. Fore wing mostly infuscated; hind tibia black basally and distally, yellow at mid-length; pronotum entirely yellow; mesoscutum entirely pale; anterior transverse carina of propodeum reaching the lateral margin; median tergites entirely pale.

Description. Holotype: male. Body length 5.6 mm. Fore wing length 5.4 mm. Fore wing mostly infuscated. Scutellar sulcus with five longitudinal carinae. Median areola of propodeum with sharp margins. Anterior transverse carina of propodeum reaching the

lateral margin. Lateral longitudinal carinae of median tergite 1 sharp. Median syntergite 2+3 1.1 times longer than wide.

Biology. Reared 1 time from Gelechiidae "same as 93-SRNP-3345.1" feeding on very new leaves of *Bursera tomentosa* (Burseraceae) in ACG dry forest at 280 m.

Etymology. *Lytopylus alejandromasisi* is named in honor of Alejandro Masis in recognition of his participation in the collaborative development of the ICE-ACG geothermal project of Pailas II, north-western Costa Rica.

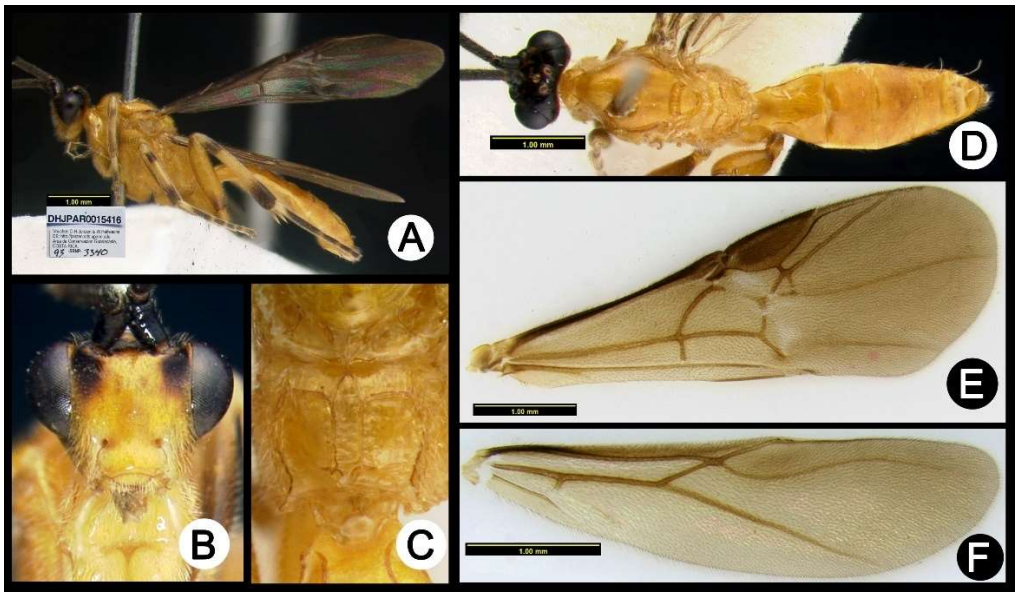


Plate 1. *Lytopylus alejandromasisi* holotype: A. lateral habitus, B. anterior head, C. propodeum, D. dorsal habitus, E. fore wing, F. hind wing.

Material examined and distribution. Holotype ♂: Costa Rica, Guanacaste, Sector Santa Rosa, Quebrada Duende, Area de Conservación Guanacaste 10.83663N -85.61144W 280m., gusaneros coll., host plant: Burseraceae *Bursera tomentosa*, host caterpillar: Gelechiidae, same as 93-SRNP-3345.1, coll. date: 7/7/1993, parasitoid eclosion date: 7/25/1993, DHJPAR0015416 93-SRNP-3340.

Lytopylus alfredomainieri Kang n. sp.

Diagnosis. Apical flagellomeres brown not distinctly paler than subapical flagellomeres; vertex of head entirely melanic; fore wing mostly infuscated; pronotum entirely pale (yellow to orange); fore tibia entirely pale (yellow to orange); mesoscutum entirely pale; anterior transverse carina of propodeum not reaching the lateral margin; median tergites entirely pale (yellow to orange); median syntergite 2+3 1.1 times longer than wide.

Description. Holotype: female. Body length 4.4 mm. Fore wing length 5.1 mm. Fore wing mostly infuscated. Pronotum entirely pale (yellow to orange). Scutellar sulcus with one median longitudinal carina. Median areola of propodeum with sharp margins. Anterior transverse carina of propodeum not reaching the lateral margin. Lateral longitudinal carinae of median tergite 1 sharp. Median syntergite 2+3 1.1 times longer than wide. Ovipositor about same length as body.

Biology. Reared 5 times from two species of *Olethreutes* (Olethreutinae, Tortricidae) leaf-tiers feeding on mature leaves of *Meliosma glabrata* (Sabiaceae) in ACG cloud forest edge at 1220 to 1276 m.

Etymology. *Lytopylus alfredomainieri* is named in honor of Alfredo Mainieri in recognition of his participation in the collaborative development of the ICE-ACG geothermal project of Pailas II, north-western Costa Rica.

Material examined and distribution. Holotype ♀: Costa Rica, Guanacaste, Sector Cacao, Sendero Derrumbe, Area de Conservación Guanacaste 10.92918N -85.46426W 1220m., Manuel Pereira coll., food plant: Sabiaceae *Meliosma glabrata*, host caterpillar: Tortricidae, Olethreutinae, *Olethreutes* Janzen188, coll. date: 2/2/2009, parasitoid eclosion date: 3/19/2009, DHJPAR0035525 09-SRNP-35036.

Paratypes: [the following have the same data as the holotype except as indicated] ♂, DHJPAR0035519 09-SRNP-35035. ♀, DHJPAR0035513 09-SRNP-35038. ♂, Sector Pailas Gemelos, 10.76928N -85.34662W, 1276m., Jose Cortez coll., host caterpillar:

Olethreutes Brown22, coll. date: 10/7/2009, parasitoid eclosion date: 11/2/2009, DHJPAR0038251 09-SRNP-57542. [same as previous except eclosion date] ♂, parasitoid eclosion date: 11/1/2009, DHJPAR0037861 09-SRNP-57540.

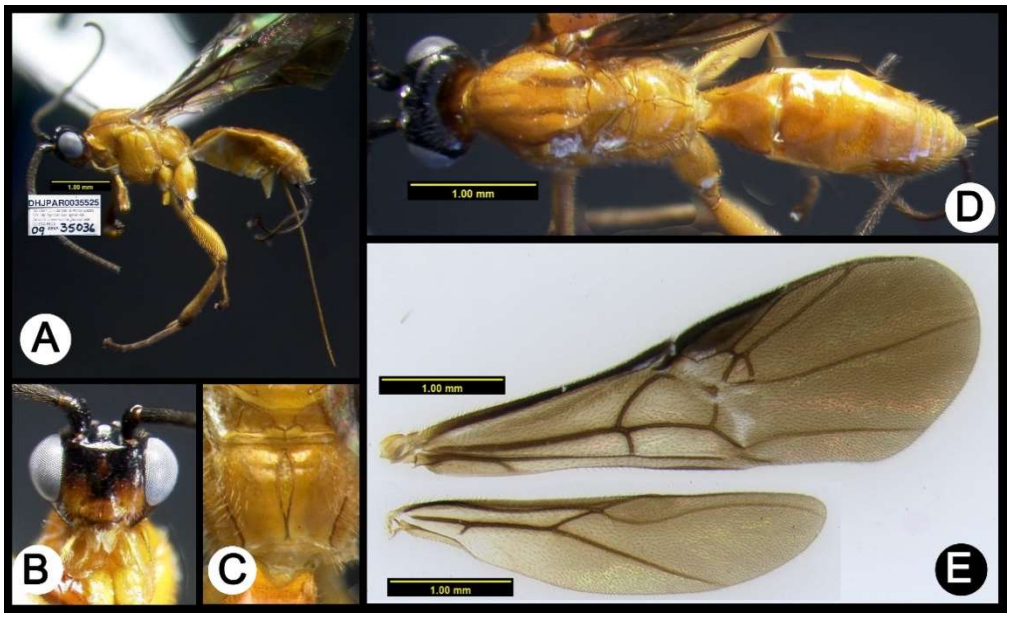


Plate 2. *Lytopylus alfredomainieri* holotype: A. lateral habitus, B. anterior head, C. propodeum, D. dorsal habitus, E. wings.

***Lytopylus anamariamongeae* Kang n. sp.**

Diagnosis. Fore wing mostly infuscated; pronotum mostly pale, anteriorly black; mesoscutum entirely pale (yellow to orange); mesopleuron mostly pale, postventrally black; scutellar sulcus lacking longitudinal carina; median tergites entirely melanic.

Description. Holotype: female. Body length 6.2 mm. Fore wing length 5.5 mm. Fore wing mostly infuscated. Scutellar sulcus lacking longitudinal carina. Median areola of propodeum with sharp margins. Anterior transverse carina of propodeum reaching the lateral margin. Lateral longitudinal carinae of median tergite 1 sharp. Median syntergite 2+3 1.5 times longer than wide. Ovipositor about same length as body.

Biology. Reared one time from *Antaeocerconota* Janzen433 (Depressariidae) a leaf-tier feeding on mature leaves of *Inga punctata* (Fabaceae) in ACG dry forest – rain forest ecotone at 540 m.

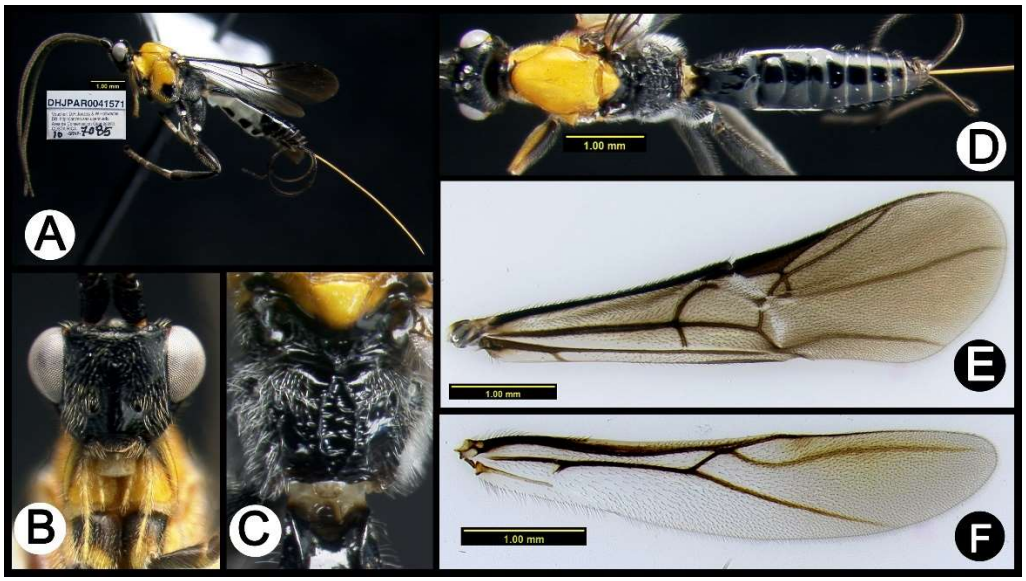


Plate 3. *Lytopylus anamariamongeae* holotype: A. lateral habitus, B. anterior head, C. propodeum, D. dorsal habitus, E. fore wing, F. hind wing.

Etymology. *Lytopylus anamariamongeae* is named in honor of Ana Maria Monge in recognition of her participation in the collaborative development of the ICE-ACG geothermal project of Pailas II, north-western Costa Rica.

Material examined and distribution. Holotype ♀: Costa Rica, Alajuela, Sector San Cristobal, Tajo Angeles, Area de Conservación Guanacaste 10.86472N -85.41531W 540m., Gloria Sihezar coll., food plant: Fabaceae *Inga punctate*, host caterpillar: Depressariidae, Stenomatinae, *Antaeocerconota* Janzen433, coll. date: 11/29/2010, parasitoid eclosion date: 12/17/2010, DHJPAR0041571 10-SRNP-7085.

***Lytopylus cesarmorai* Kang n. sp.**

Diagnosis. Fore wing mostly infuscated; scutellar sulcus with one median longitudinal carina; median tergites entirely melanic; lateral tergites one and two entirely white.

Description. Holotype: female. Body length 5.7 mm. Fore wing length 5.4 mm. Fore wing mostly infuscated. Scutellar sulcus with one median longitudinal carina. Median areola of propodeum with sharp margins. Anterior transverse carina of propodeum absent. Lateral longitudinal carinae of median tergite 1 sharp. Median syntergite 2+3 1.5 times longer than wide. Ovipositor slightly longer than body.

Biology. Reared 2 times from *Stenoma* BioLep82 (Depressariidae) feeding on mature leaves of *Apeiba membranacea* (Malvaceae) in ACG rain forest at 527 m.

Etymology. *Lytopylus cesarmorai* is named in honor of Cesar Mora in recognition of his participation in the collaborative development of the ICE-ACG geothermal project of Pailas II, north-western Costa Rica.

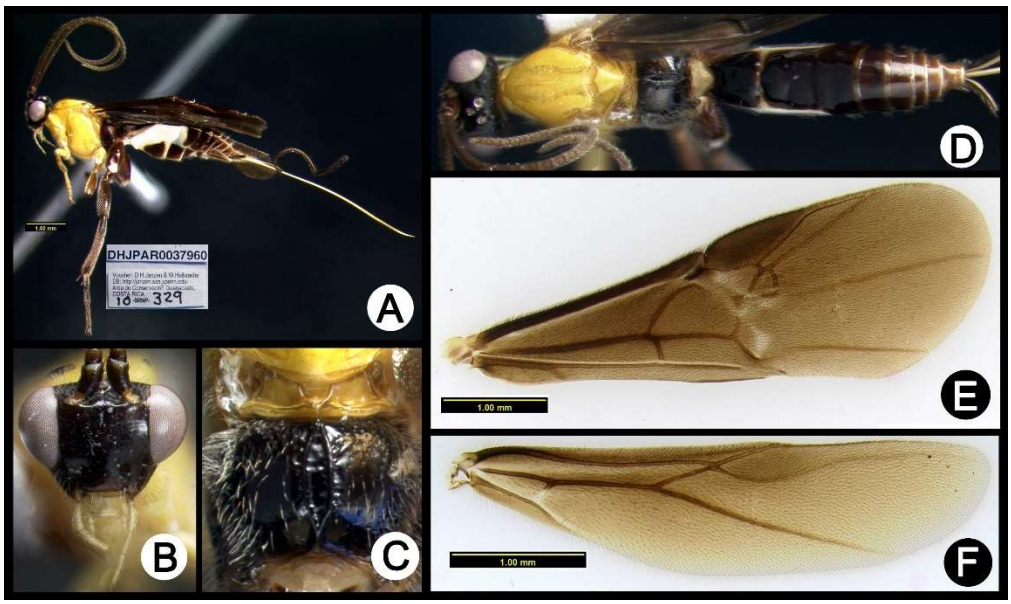


Plate 4. *Lytopylus cesarmorai* holotype: A. lateral habitus, B. anterior head, C. propodeum, D. dorsal habitus, E. fore wing, F. hind wing.

Material examined and distribution. Holotype ♀: Costa Rica, Alajuela, Sector San Cristobal, Sendero Huerta, Area de Conservación Guanacaste 10.9305N -85.37223W 527m., Carolina Cano coll., food plant: Malvaceae *Apeiba membranacea*, host

caterpillar: Depressariidae, Stenomatinae, *Stenoma* BioLep82, coll. date: 1/11/2010, parasitoid eclosion date: 2/5/2010, DHJPAR0037960 10-SRNP-329.

Paratype: [the following have the same data as the holotype except as indicated] ♂, parasitoid eclosion date: 2/9/2010, DHJPAR0038304 10-SRNP-330.

***Lytopylus chrysokeras* (Sharkey)**

Austroearinus chrysokeras Sharkey, 2006.

Lytopylus chrysokeras Sharkey, (Sharkey et al., 2016).

Diagnosis. Apical flagellomeres usually bright yellow, always distinctly paler than subapical flagellomeres; fore wing mostly infuscated; hind tibia black apically; mesoscutum entirely pale; median tergites entirely pale (yellow to orange).

Biology. Reared 48 times from 7 species of dichomeridine Gelechiidae feeding on 7 species of mature leaves of Malvaceae, Violaceae, Rubiaceae, Asteraceae, and Fabaceae growing in ACG rain forest at 240 to 645 m.

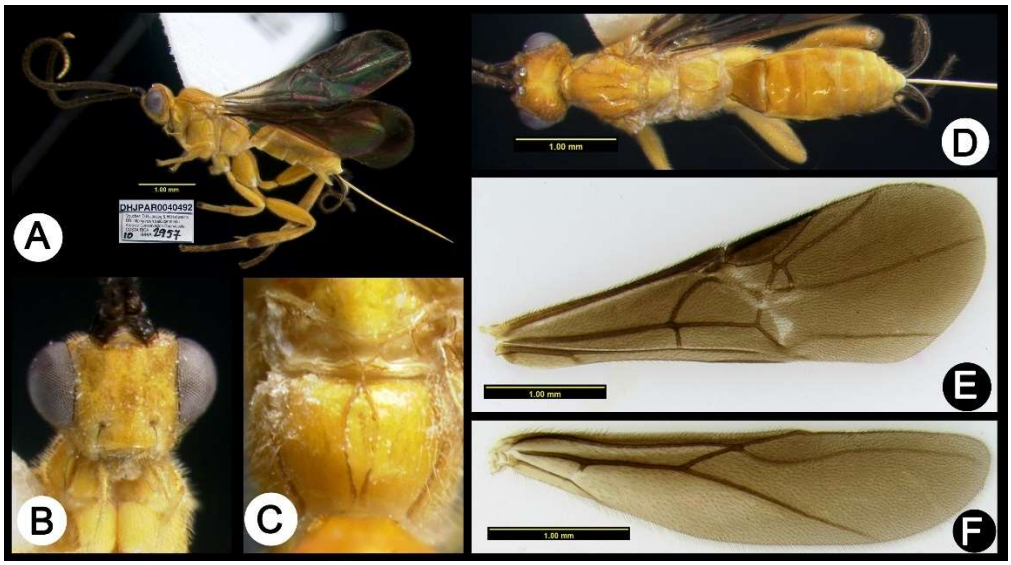


Plate 5. *Lytopylus chrysokeras*: A. lateral habitus, B. anterior head, C. propodeum, D. dorsal habitus, E. fore wing, F. hind wing.

Material examined and distribution. ♀: Costa Rica, Alajuela, Sector San Cristobal, Tajo Angeles, Area de Conservación Guanacaste 10.86472N -85.41531W 540m.,

Carolina Cano coll., food plant: Violaceae *Rinorea squamata*, host caterpillar: Gelechiidae, Dichomeridinae, gelJanzen01 Janzen485, coll. date: 6/10/2010, parasitoid eclosion date: 6/29/2010, DHJPAR0040492 10-SRNP-2957. [the following have the same data as previous except as indicated] ♂, parasitoid eclosion date: 6/26/2010, DHJPAR0040344 10-SRNP-2949. ♂, parasitoid eclosion date: 6/27/2010, DHJPAR0040476 10-SRNP-2950. ♂, parasitoid eclosion date: 6/30/2010, DHJPAR0040485 10-SRNP-2956. ♂, parasitoid eclosion date: 6/27/2010, DHJPAR0040487 10-SRNP-2961. ♀, Gloria Sihezar coll., coll. date: 6/15/2010, parasitoid eclosion date: 7/2/2010, DHJPAR0040473 10-SRNP-3205. ♀, Gloria Sihezar coll. food plant: Malvaceae *Mortoniodendron costaricense*, host caterpillar: gelJanzen01 Janzen356, coll. date: 7/8/2010, parasitoid eclosion date: 7/25/2010, DHJPAR0040505 10-SRNP-3659. ♀, Elda Araya coll., food plant: Malvaceae *Mortoniodendron costaricense*, host caterpillar: gelJanzen01 Janzen356, coll. date: 7/8/2010, parasitoid eclosion date: 7/23/2010, DHJPAR0040460 10-SRNP-3657. ♀, Osvaldo Espinoza coll., food plant: *Rinorea deflexiflora*, host caterpillar: gelJanzen01 Janzen179, coll. date: 6/4/2014, parasitoid eclosion date: 6/20/2014, DHJPAR0055352 14-SRNP-2786. ♂, Finca San Gabriel, 10.87766N -85.39343W 645m., Carolina Cano coll., food plant: Malvaceae *Mortoniodendron costaricense*, host caterpillar: gelJanzen01 Janzen356, coll. date: 11/16/2012, parasitoid eclosion date: 12/5/2012, DHJPAR0051373 12-SRNP-4943. [same as previous except coll. date and eclosion date] ♂, coll. date: 11/30/2012, parasitoid eclosion date: 12/21/2012, DHJPAR0051162 12-SRNP-5322. ♀, Gloria Sihezar coll., coll. date: 6/2/2012, parasitoid eclosion date: 6/28/2012, DHJPAR0049276 12-SRNP-2199. ♀, Elda Araya coll., coll. date: 10/11/2012, parasitoid eclosion date: 11/4/2012, DHJPAR0051364 12-SRNP-4459. [the following have the same data as the holotype except as indicated] ♂, Cementerio Viejo, 10.88111N -85.38889W 570m., Gloria Sihezar coll., food plant: Malvaceae *Mortoniodendron costaricense*, host caterpillar: gelJanzen01 Janzen356, coll. date: 7/30/2014, parasitoid eclosion date: 8/17/2014, DHJPAR0057739 14-SRNP-3535. ♂, Rio Blanco Abajo, 10.90037N -85.37254W 500m., food plant: Malvaceae *Mortoniodendron costaricense*, host caterpillar: gelJanzen01 Janzen356, coll. date: 6/29/2009, parasitoid eclosion date: 7/19/2009, DHJPAR0040070 09-SRNP-3201. ♀, Sector Rincon Rain Forest, Rio Francia

Arriba, 10.89666N -85.29003W 400m., Jose Perez coll., food plant: Fabaceae *Dialium guianense*, host caterpillar: *Dichomeris* Janzen512, coll. date: 1/19/2011, parasitoid eclosion date: 2/7/2011, DHJPAR0042837 11-SRNP-40332. [same as previous except and eclosion date] ♀, parasitoid eclosion date: 2/10/2011, DHJPAR0042835 11-SRNP-40333. ♀, parasitoid eclosion date: 2/9/2011, DHJPAR0043002 11-SRNP-40335. ♀, Sector Rincon Rain Forest, Sendero Anonas, 10.90528N -85.27882W 405m., Jose Perez coll., food plant: Violaceae *Rinorea deflexiflora*, coll. date: 4/6/2012, parasitoid eclosion date: 5/1/2012, DHJPAR0049388 12-SRNP-41389. [same as previous except as indicated] ♂, food plant: *Rinorea hummelii*, coll. date: 2/12/2013, parasitoid eclosion date: 2/26/2013, DHJPAR0051817 13-SRNP-40644. ♀, Anabelle Cordoba coll., food plant: *Rinorea hummelii*, coll. date: 5/20/2014, parasitoid eclosion date: 6/6/2014, DHJPAR0055505 14-SRNP-42491. ♂, Anabelle Cordoba coll., coll. date: 5/20/2014, parasitoid eclosion date: 6/5/2014, DHJPAR0055528 14-SRNP-42497. [same as previous except as indicated] ♀, parasitoid eclosion date: 6/8/2014, DHJPAR0055522 14-SRNP-42501. ♂, parasitoid eclosion date: 6/7/2014, DHJPAR0055527, 14-SRNP-42505. ♀, parasitoid eclosion date: 6/11/2014, DHJPAR0055353, 14-SRNP-42508. ♂, coll. date: 5/23/2014, parasitoid eclosion date: 6/7/2014, DHJPAR0055543 14-SRNP-42574. ♂, coll. date: 5/23/2014, parasitoid eclosion date: 6/9/2014, DHJPAR0055490 14-SRNP-42578. ♂, coll. date: 5/23/2014, parasitoid eclosion date: 6/7/2014, DHJPAR0055507 14-SRNP-42579. ♀, coll. date: 5/30/2014, parasitoid eclosion date: 6/18/2014, DHJPAR0055513 14-SRNP-42656. ♀, coll. date: 6/2/2014, parasitoid eclosion date: 6/14/2014, DHJPAR0055504 14-SRNP-42660. ♀, Sector Rincon Rain Forest, Jacobo, 10.94076N -85.3177W 461m., Petrona Rios coll., food plant: *Rinorea deflexiflora*, host caterpillar: gelJanzen01 Janzen179, coll. date: 6/7/2014, parasitoid eclosion date: 6/23/2014, DHJPAR0055986 14-SRNP-80721. ♂, Sector Rincon Rain Forest, Conguera, 10.91589N -85.26631W 420m., Jose Perez coll., food plant: Asteraceae *Koanophyllon hylonoma*, host caterpillar: *Dichomeris* Janzen703, coll. date: 7/1/2009, parasitoid eclosion date: 7/22/2009, DHJPAR0040067 09-SRNP-41505. ♂, Guanacaste, Sector Pitilla, Ingas, 11.00311N -85.42041W 580m., Natalia Santamaria coll. food plant: *Rinorea deflexiflora*, host caterpillar: gelJanzen01 Janzen781, coll. date: 5/29/2004, parasitoid eclosion date: 6/21/2004, DHJPAR0015527 04-SRNP-33046. ♂, Guanacaste,

Sector Pitilla, Sendero Trichoptera, 10.98571N -85.41869W 655m., Calixto Moraga coll. food plant: *Rinorea sylvatica*, coll. date: 10/8/2009, parasitoid eclosion date: 10/27/2009, DHJPAR0040065 09-SRNP-32711. ♂, Guanacaste, Sector Pitilla, Sendero Laguna, 10.9888N -85.42336W 680m., Roster Moraga coll., food plant: Rubiaceae *Chiococca alba*, coll. date: 1/8/2010, parasitoid eclosion date: 1/28/2010, DHJPAR0038356 10-SRNP-30103. ♂, Guanacaste, Sector Pitilla, Leonel, 10.99637N -85.40195W 510m., Dinia Martinez coll., food plant: *Rinorea sylvatica*, coll. date: 2/4/2010, parasitoid eclosion date: 2/22/2010, DHJPAR0039071 10-SRNP-70619. ♀, Guanacaste, Sector Pitilla, Sendero Orosilito, 10.98332N -85.43623W 900m., Freddy Quesada coll., food plant: Malpighiaceae *Hiraea reclinata*, host caterpillar: gelJanzen01 Janzen19, coll. date: 7/25/2013, parasitoid eclosion date: 8/15/2013, DHJPAR0052673 13-SRNP-30993. ♂, Guanacaste, Sector Del Oro, Quebrada Raiz, 11.02865N -85.48669W 280m., Elieth Cantillano coll. food plant: *Rinorea deflexiflora*, coll. date: 5/18/2010, parasitoid eclosion date: 6/3/2010, DHJPAR0040331 10-SRNP-20751. [same as previous except collector and eclosion date] ♂, Roster Moraga coll., parasitoid eclosion date: 6/1/2010, DHJPAR0040335 10-SRNP-20829. ♂, Roster Moraga coll., parasitoid eclosion date: 6/2/2010, DHJPAR0040503 10-SRNP-20862.

***Lytopylus eddysanchezi* Kang n. sp.**

Diagnosis. Vertex of head entirely yellow; fore wing with one black band; mid tibia mostly melanic, yellow basally.

Description. Holotype: female. Body length 6.0 mm. Fore wing length 5.5 mm. Fore wing with one black band. Scutellar sulcus with one median longitudinal carina. Median areola of propodeum with sharp margins. Anterior transverse carina of propodeum absent. Lateral longitudinal carinae of median tergite 1 sharp. Median syntergite 2+3 1.2 times longer than wide. Ovipositor about same length as body.

Biology. Reared 11 times from one species leaf-tier in the Depressariidae, feeding on mature leaves of *Meliosma glabrata (*Sabiaceae) in ACG rain forest at 540-645 m elevation.

Etymology. *Lytopylus eddysanchezi* is named in honor of Eddy Sanchez in recognition of his participation in the collaborative development of the ICE-ACG geothermal project of Pailas II, north-western Costa Rica.

Material examined and distribution. Holotype ♀: Costa Rica, Alajuela, Sector San Cristobal, Finca San Gabriel, Area de Conservación Guanacaste 10.87766N -85.39343W 645m., Gloria Sihezar coll., food plant: Sabiaceae *Meliosma glabrata*, host caterpillar: Depressariidae, subfamily unknown, elachJanzen01 Janzen900, coll. date: 1/7/2015, parasitoid eclosion date: 2/7/2015, DHJPAR0056978 15-SRNP-76.

Paratypes: [the following have the same data as the holotype except as indicated] ♂, Sendero Corredor, 10.87868N -85.38963W 620m., Elda Araya coll., coll. date: 11/7/2009, parasitoid eclosion date: 12/5/2009, DHJPAR0038240 09-SRNP-5810. ♂, Sendero Corredor, 10.87868N -85.38963W 620m., coll. date: 7/25/2013, parasitoid eclosion date: 8/17/2013, DHJPAR0052903 13-SRNP-3847. ♀, Tajo Angeles, 10.86472N -85.41531W 540m., coll. date: 9/20/2010, parasitoid eclosion date: 10/14/2010, DHJPAR0041600 10-SRNP-5483. ♂, Sendero Carmona, 10.87621N -85.38632W 670m., coll. date: 3/25/2012, parasitoid eclosion date: 4/18/2012, DHJPAR0049278 12-SRNP-1195. ♀, coll. date: 2/24/2014, parasitoid eclosion date: 3/31/2014, DHJPAR0055232 14-SRNP-1103. ♂, Elda Araya coll., coll. date: 11/26/2009, parasitoid eclosion date: 12/22/2009, DHJPAR0038208 09-SRNP-6347. [same as previous except as coll. date and eclosion date] ♀, coll. date: 11/30/2009, parasitoid eclosion date: 1/1/2010, DHJPAR0038180 09-SRNP-6472. ♂, coll. date: 11/30/2009, parasitoid eclosion date: 12/23/2009, DHJPAR0038231 09-SRNP-6474. ♂, coll. date: 11/30/2009, parasitoid eclosion date: 12/21/2009, DHJPAR0038225 09-SRNP-6476. ♂, coll. date: 12/16/2012, parasitoid eclosion date: 1/13/2013, DHJPAR0051357 12-SRNP-5607.

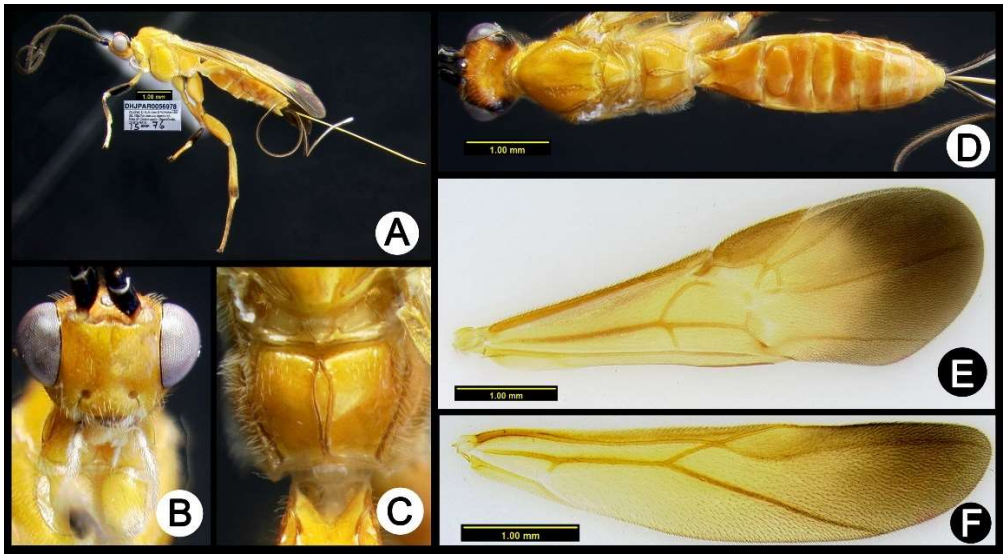


Plate 6. *Lytopylus eddysanchezi* holotype: A. lateral habitus, B. anterior head, C. propodeum, D. dorsal habitus, E. fore wing, F. hind wing.

***Lytopylus eliethcantillanoae* Kang n. sp.**

Diagnosis. Fore wing mostly infuscated; mesoscutum entirely melanic; anterior transverse carina of propodeum absent; median areola of propodeum narrow and not closed posteriorly; lateral longitudinal carinae of median tergite 1 sharp; median tergites entirely reddish orange.

Description. Holotype: male. Body length 5.2 mm. Fore wing length 5.3 mm. Fore wing mostly infuscated. Scutellar sulcus with three longitudinal carinae. Median areola of propodeum with sharp margins. Anterior transverse carina of propodeum absent. Lateral longitudinal carinae of median tergite 1 sharp. Median syntergite 2+3 1.1 times longer than wide. Ovipositor longer than metasoma, but shorter than body.

Biology. Reared perhaps 1 time from elachJanzen01 Janzen873 (Depressariidae) feeding on *Malvaviscus arboreus* (Malvaceae) in ACG dry forest – rain forest ecotone at 840 m.

Etymology. *Lytopylus eliethcantillanoae* is named in honor of Elieth Cantillano in recognition of her participation in the collaborative development of the ICE-ACG geothermal project of Pailas II, north-western Costa Rica.

Material examined and distribution. Holotype ♂: Costa Rica, Guanacaste, Sector Santa Maria, Estacion Santa Maria, Area de Conservación Guanacaste 10.76448N -85.31161W 840m., Jose Cortez coll., food plant: Malvaceae *Malvaviscus arboreus*, host caterpillar: Depressariidae, subfamily unknown, elachJanzen01 Janzen873, coll date: 4/26/2009, parasitoid eclosion date: 5/12/2009, DHJPAR0035345 09-SRNP-55925.

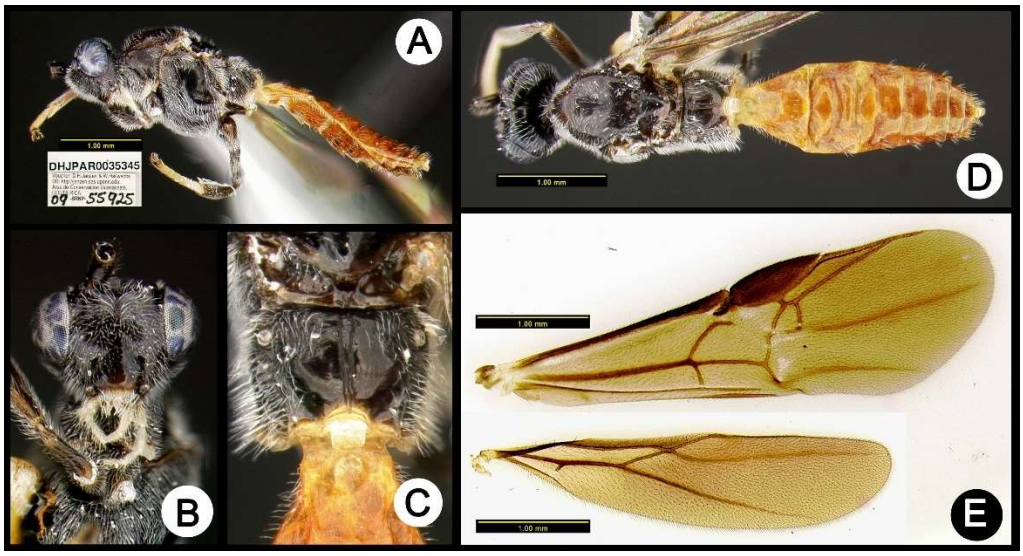


Plate 7. *Lytopylus eliethcantillanoae* holotype: A. lateral habitus, B. anterior head, C. propodeum, D. dorsal habitus, E. wings.

***Lytopylus ericchapmani* Kang n. sp.**

Diagnosis. Fore wing with two black bands; pronotum anteriorly black and posteriorly pale.

Description. Holotype: female. Body length 5.8 mm. Fore wing length 5.7 mm. Fore wing with two black bands. Scutellar sulcus lacking longitudinal carina. Anterior transverse carina of propodeum absent. Median areola of propodeum with sharp margins.

Median areola of propodeum narrow. Lateral longitudinal carinae of median tergite 1 sharp. Median syntergite 2+3 1.7 times longer than wide. Ovipositor slightly longer than body.

Biology. Reared 5 times but only from the leaf-tier *Stenoma adytodes* (Depressariidae) feeding on mature leaves of *Pouteria juruana* (Sapotaceae) at the intersection of the ACG dry forest and rain forest ecosystems at 722 m elevation.

Etymology. Named in honor of Dr. Eric G. Chapman, research associate in the Department of Entomology at the University of Kentucky, for his kindly advice.

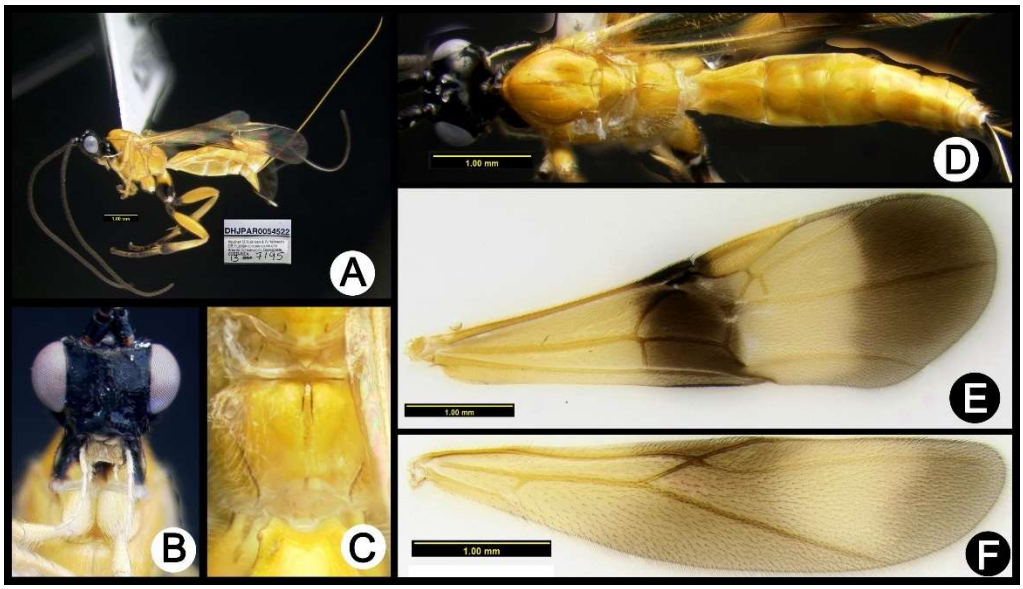


Plate 8. *Lytopylus ericchapmani* holotype: A. lateral habitus, B. anterior head, C. propodeum, D. dorsal habitus, E. fore wing, F. hind wing.

Material examined and distribution. Holotype ♀: Costa Rica, Alajuela, Sector San Cristobal, Jardin Estrada, Area de Conservación Guanacaste 10.86546N -85.39694W 722m., Carolina Cano coll., food plant: Sapotaceae *Pouteria juruana*, host caterpillar: Depressariidae, Stenomatinae, *Stenoma adytodes*, coll. date: 12/10/2013, parasitoid eclosion date: 1/12/2014, DHJPAR0054533 13-SRNP-7194.

Paratypes: [the following have the same data as the holotype except as indicated] ♀, coll. date: 2/5/2013, parasitoid eclosion date: 1/4/2014, DHJPAR0054527 13-SRNP-

6898. ♀, parasitoid eclosion date: 1/9/2014, DHJPAR0054522 13-SRNP-7195. ♀, parasitoid eclosion date: 1/7/2014, DHJPAR0055238 13-SRNP-7198. ♂, Elda Araya coll., coll. date: 12/5/2013, parasitoid eclosion date: 12/26/2013, DHJPAR0054526 13-SRNP-6907.

***Lytopylus gahyunae* Kang n. sp.**

Diagnosis. Fore wing mostly infuscated; hind coxa entirely pale; mesoscutum entirely melanic; scutellar sulcus with one median longitudinal carina; anterior transverse carina of propodeum reaching the lateral margin; median tergites mostly pale with posterior terga black; median syntergite 2+3 1.4 times longer than wide.

Description. Holotype: female. Body length 7.1 mm. Fore wing length 6.4 mm. Fore wing mostly infuscated. Scutellar sulcus with one median longitudinal carina. Median areola of propodeum with sharp margins. Anterior transverse carina of propodeum reaching the lateral margin. Lateral longitudinal carinae of median tergite 1 sharp. Median syntergite 2+3 1.4 times longer than wide. Ovipositor slightly longer than body.

Biology. Reared 43 times from 6 species of *Antaeotricha* (40) and *Stenoma* (2) (Depressariidae) feeding on mature leaves of 3 species of *Guarea* and 1 of *Trichilia* (Meliaceae) in ACG rain forest from 380 to 620 m.

Etymology. *Lytopylus gahyunae* is named in honor of Gahyun Park, wife of the first author.

Material examined and distribution. Holotype♀: Costa Rica, Alajuela, Sector San Cristobal, Rio Areno, Area de Conservación Guanacaste 10.91407N -85.38174W 460m., Osvaldo Espinoza coll., food plant: Meliaceae *Guarea bullata*, host caterpillar: Depressariidae, Stenomatinae, *Antaeotricha* Janzen09, coll. date: 6/4/2009, parasitoid eclosion date: 6/26/2009, DHJPAR0035229 09-SRNP-2480.

Paratypes: [the following have the same data as the holotype except as indicated] 2♀, coll. date: 6/4/2009, parasitoid eclosion date: 6/22/2009, DHJPAR0035298 09-SRNP-

2471, DHJPAR0035294 09-SRNP-2474. ♀, parasitoid eclosion date: 6/23/2009, DHJPAR0036371 09-SRNP-2475. ♀, Elda Araya coll., food plant: *Guarea rhopalocarpa*, coll. date: 5/4/2009, parasitoid eclosion date: 6/21/2009, DHJPAR0035231 09-SRNP-2463. ♀, Puente Palma, 10.9163N -85.37869W 460m., Elda Araya coll., coll. date: 8/14/2009, parasitoid eclosion date: 8/27/2009, DHJPAR0036721 09-SRNP-4195. [same as previous except coll. date and eclosion date] ♀, coll. date: 9/13/2009, parasitoid eclosion date: 10/2/2009, DHJPAR0036686 09-SRNP-4769. ♂, Puente Palma, 10.9163N -85.37869W 460m., Carolina Cano coll., food plant: *Guarea kegelii*, coll. date: 11/10/2011, parasitoid eclosion date: 11/26/2011, DHJPAR0046956 11-SRNP-4452. ♀, Puente Palma, 10.9163N -85.37869W 460m., Gloria Sihezar coll., host caterpillar: *Antaeotricha* Janzen12, coll. date: 11/24/2012, parasitoid eclosion date: 12/27/2012, DHJPAR0051365 12-SRNP-5219. ♂, Tajo Angeles, 10.86472N -85.41531W 540m., Gloria Sihezar coll., food plant: *Guarea kegelii*, host caterpillar: Depressariinae, *Antaeotricha* Janzen07, coll. date: 9/24/2011, parasitoid eclosion date: 10/14/2011, DHJPAR0045788 11-SRNP-3784. [same as previous except coll. date and eclosion date] ♀, host caterpillar: Stenomatinae, coll. date: 11/6/2011, parasitoid eclosion date: 11/24/2011, DHJPAR0046745 11-SRNP-4367. ♀, host caterpillar: Stenomatinae, *Antaeotricha* Janzen09, coll. date: 11/22/2011, parasitoid eclosion date: 12/13/2011, DHJPAR0046744 11-SRNP-4560. ♀, Sendero Huerta, 10.9305N -85.37223W 527m., Gloria Sihezar coll., coll. date: 7/2/2012, parasitoid eclosion date: 7/27/2012, DHJPAR0049943 12-SRNP-2713. [same as previous except coll. date and eclosion date] ♀, 12/2/2012 12/24/2012, DHJPAR0051374 12-SRNP-5357. [same as previous except food plant, coll. date and eclosion date] 1♀, 1♂, food plant: *Guarea kegelii*, coll. date: 12/8/2012, parasitoid eclosion date: 1/1/2013, DHJPAR0051349 12-SRNP-5511, coll. date: 12/8/2012, parasitoid eclosion date: 12/31/2012, DHJPAR0051370 12-SRNP-5512. ♀, Elda Araya coll., host caterpillar: *Stenoma* Janzen144, coll. date: 7/21/2012, parasitoid eclosion date: 8/14/2012, DHJPAR0049649 12-SRNP-3117. [same as previous except food plant, coll. date and eclosion date] 2♀, food plant: *Guarea kegelii*, coll. date:12/23/2012, parasitoid eclosion date: 1/10/2012, DHJPAR0051360 12-SRNP-5749, coll. date: 12/23/2012, parasitoid eclosion date: 1/7/2013, DHJPAR0051371 12-SRNP-5750. ♀, Sendero Perdido, 10.8794N -85.38607W 620m., Carolina Cano coll., food

plant: *Guarea kegelii*, coll. date: 10/9/2013, parasitoid eclosion date: 10/29/2013, DHJPAR0053649 13-SRNP-5456. [same as previous except coll. date and eclosion date] 2♂, 10/11/2013 10/26/2013, DHJPAR0053652 13-SRNP-5535, coll. date: 10/11/2013, parasitoid eclosion date: 10/29/2013, DHJPAR0053655 13-SRNP-5537. [same as previous except food plant, coll. date and eclosion date] ♀, food plant: *Trichilia adolfi*, coll. date: 10/9/2013, parasitoid eclosion date: 10/30/2013, DHJPAR0053654 13-SRNP-5459. ♂, Sendero Perdido, 10.8794N -85.38607W 620m., Gloria Sihezar coll., food plant: *Guarea kegelii*, 9/24/2013 10/9/2013, DHJPAR0053658 13-SRNP-4969. [same as previous except caterpillar, coll. date and eclosion date] ♂, host caterpillar: *Antaeotricha* Janzen07, 10/25/2013 11/22/2013, DHJPAR0054538 13-SRNP-5833. ♂, Sendero Perdido, 10.8794N -85.38607W 620m., Elda Araya coll., food plant: *Guarea kegelii*, coll. date: 1/9/2014, parasitoid eclosion date: 1/23/2014, DHJPAR0054515 14-SRNP-170. [same as previous except coll. date and eclosion date] ♂, 1/9/2014 1/25/2014, DHJPAR0054517 14-SRNP-171. ♀, Sendero Perdido, 10.8794N -85.38607W 620m., Elda Araya coll., food plant: *Guarea rhopalocarpa*, coll. date: 11/29/2013, parasitoid eclosion date: 12/29/2013, DHJPAR0054539 13-SRNP-6855. [same as previous except caterpillar and eclosion date] ♀, host caterpillar: *Antaeotricha thapsinopa*, parasitoid eclosion date: 12/31/2013, DHJPAR0054532 13-SRNP-6857. ♀, Sendero Perdido, 10.8794N -85.38607W 620m., Elda Araya coll., food plant: *Trichilia adolfi*, host caterpillar: *Antaeotricha* Janzen07, 2/1/2010 2/14/2010, DHJPAR0038910 10-SRNP-664. ♀, Finca San Gabriel, 10.87766N -85.39343W 645m., Carolina Cano coll., food plant: *Guarea kegelii*, host caterpillar: *Antaeotricha* Janzen07, coll. date: 10/18/2013, parasitoid eclosion date: 11/2/2013, DHJPAR0054519 13-SRNP-5682. ♂, Finca San Gabriel, 10.87766N -85.39343W 645m., Carolina Cano coll., food plant: *Guarea rhopalocarpa*, host caterpillar: *Stenoma* Janzen144, coll. date: 8/11/2013, parasitoid eclosion date: 8/29/2013, DHJPAR0053645 13-SRNP-4184. ♀, Finca San Gabriel, 10.87766N -85.39343W 645m., Elda Araya coll., food plant: *Guarea kegelii*, coll. date: 1/6/2014, parasitoid eclosion date: 1/24/2014, DHJPAR0054511 14-SRNP-101. ♂, Sendero Palo Alto, 10.88186N -85.38221W 570m., Carolina Cano coll., food plant: *Guarea rhopalocarpa*, coll. date: 9/12/2013, parasitoid eclosion date: 9/29/2013, DHJPAR0053618 13-SRNP-4752. [same as previous except eclosion date] ♂, parasitoid

eclosion date: 10/2/2013, DHJPAR0053621 13-SRNP-4754. ♀, Cementerio Viejo, 10.88111N -85.38889W 570m., Carolina Cano coll., food plant: *Guarea kegelii*, coll. date: 9/10/2013, parasitoid eclosion date: 10/1/2013, DHJPAR0053611 13-SRNP-4708. [same as previous except eclosion date] ♂, parasitoid eclosion date: 9/30/2013, DHJPAR0053619 13-SRNP-4709. [same as previous except caterpillar, coll. date and eclosion date] ♀, host caterpillar: *Antaeotricha ribbei* 12/3/2013 12/21/2013, DHJPAR0054520 13-SRNP-6878. [same as previous except coll. date and eclosion date] ♀, 12/3/2013 12/21/2013, DHJPAR0054534 13-SRNP-6879. ♂, Sendero Corredor, 10.87868N -85.38963W 620m., Carolina Cano coll., food plant: *Trichilia adolfi*, host caterpillar: Depressariinae, *Antaeotricha* Janzen09, coll. date: 1/3/2014, parasitoid eclosion date: 1/25/2014, DHJPAR0054518 14-SRNP-50. ♀, Rio Blanco Abajo, 10.90037N -85.37254W 500m., Elda Araya coll., coll. date: 8/11/2009, parasitoid eclosion date: 8/27/2009, DHJPAR0036722 09-SRNP-4170. ♂, Guanacaste, Sector Del Oro, Margarita, 11.03234N -85.43954W 380m., Lucia Ríos coll., host caterpillar: *Antaeotricha thapsinopa*, coll. date: 1/15/2005, parasitoid eclosion date: 2/1/2005, DHJPAR0015317 05-SRNP-20306.

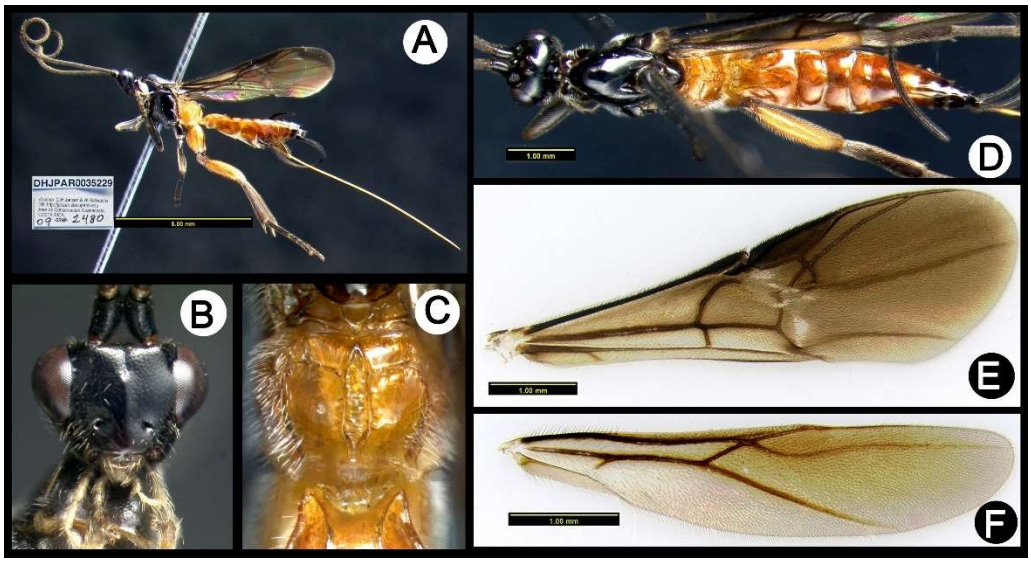


Plate 9. *Lytopylus gahyunae* holotype: A. lateral habitus, B. anterior head, C. propodeum, D. dorsal habitus, E. fore wing, F. hind wing.

***Lytopylus gisukae* Kang n. sp.**

Diagnosis. Vertex of head mostly pale; fore wing mostly infuscated with a quadrate second submarginal cell; mesoscutum entirely pale (yellow to orange); median areola of propodeum narrow; anterior transverse carina of propodeum not reaching the lateral margin; median tergites entirely pale (yellow to orange).

Description. Holotype: female. Body length 5.0 mm. Fore wing length 5.0 mm. Fore wing mostly infuscated with a quadrate second submarginal cell. Scutellar sulcus with one median longitudinal carina. Median areola of propodeum narrow with sharp margins. Anterior transverse carina of propodeum not reaching the lateral margin. Lateral longitudinal carinae of median tergite 1 sharp. Median syntergite 2+3 1.2 times longer than wide. Ovipositor longer than metasoma, but shorter than body.

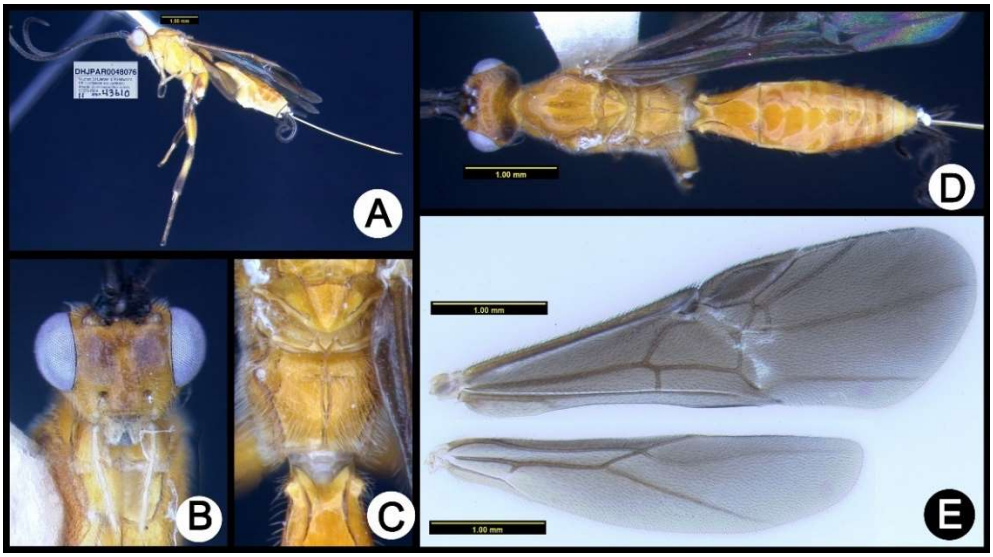


Plate 10. *Lytopylus gisukae* holotype: A. lateral habitus, B. anterior head, C. propodeum, D. dorsal habitus, E. wings.

Biology. Reared 1 time from *Antaeotricha* Janzen405 (Stenomatinae, Depressariidae) feeding on mature leaves of *Astrocaryum alatum* (Arecaceae) in ACG rain forest at 420 m.

Etymology. *Lytopylus gisukae* is named in honor of Gisuk Lee, mother-in-law of the first author.

Material examined and distribution. Holotype ♀: Costa Rica, Alajuela, Sector Rincon Rain Forest, Sendero Venado, Area de Conservación Guanacaste 10.89678N -85.27001W 420m., Pablo Umaña coll., food plant: Arecaceae *Astrocaryum alatum*, host caterpillar: Depressariidae, Stenomatinae, *Antaeotricha* Janzen405, coll. date: 8/1/2011, parasitoid eclosion date: 9/11/2011, DHJPAR0048076 11-SRNP-43610.

***Lytopylus guillermopereirai* Kang n. sp.**

Diagnosis. Fore wing mostly infuscated; mesoscutum entirely melanic; scutellar sulcus lacking longitudinal carina; median tergites entirely melanic.

Description. Holotype: female. Body length 5.4 mm. Fore wing length 4.5 mm. Fore wing mostly infuscated. Scutellar sulcus lacking longitudinal carina. Median areola of propodeum with sharp margins. Anterior transverse carina of propodeum reaching the lateral margin. Lateral longitudinal carinae of median tergite 1 sharp. Median syntergite 2+3 1.3 times longer than wide.

Biology. Reared 1 time from elachJanzen01 Janzen726 (Depressariidae) feeding on *Sloanea faginea* (Elaeocarpaceae) in ACG rain forest at 645 m.

Etymology. *Lytopylus guillermopereirai* is named in honor of Guillermo Pereira in recognition of his participation in the collaborative development of the ICE-ACG geothermal project of Pailas II, north-western Costa Rica.

Material examined and distribution. Holotype ♂: Costa Rica, Alajuela, Sector San Cristobal, Finca San Gabriel, Area de Conservación Guanacaste 10.87766N -85.39343W 645m., Gloria Sihezar coll., food plant: Elaeocarpaceae *Sloanea faginea*, host caterpillar: Depressariidae, subfamily unknown, elachJanzen01 Janzen726, coll. date: 2/24/2014, parasitoid eclosion date: 3/17/2014, DHJPAR0055234 14-SRNP-1101.

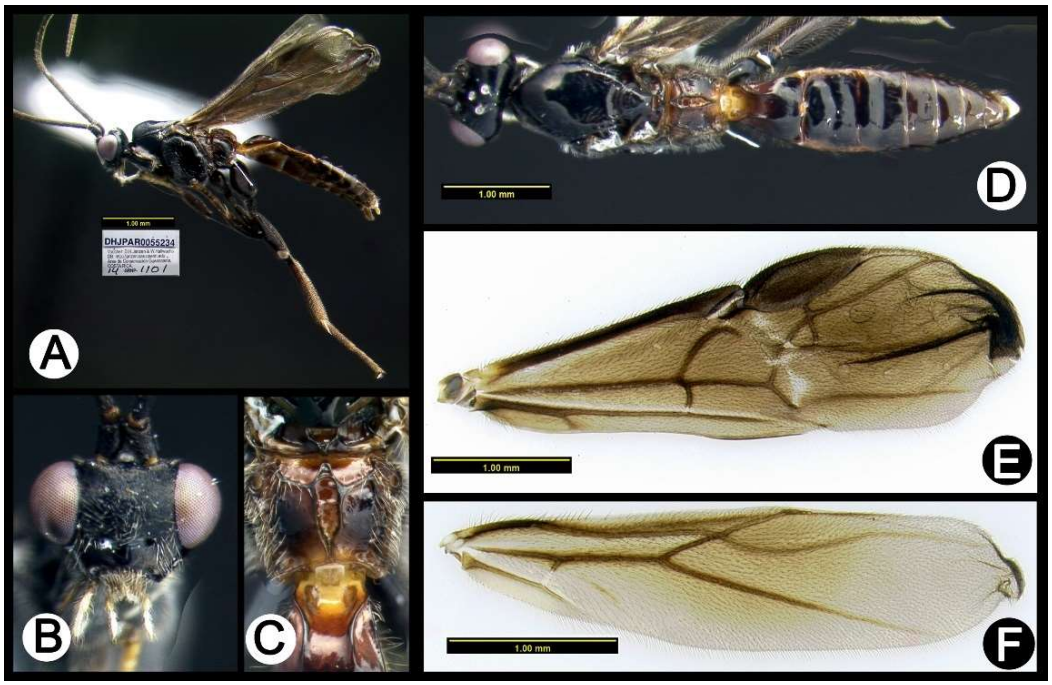


Plate 11. *Lytopylus guillermopereirai* holotype: A. lateral habitus, B. anterior head, C. propodeum, D. dorsal habitus, E. fore wing, F. hind wing.

Lytopylus gustavoindunii Kang n. sp.

Diagnosis. Apical flagellomeres brown not distinctly paler than subapical flagellomeres; vertex of head entirely pale; fore wing mostly infuscated with a triangular second submarginal cell; mesoscutum entirely pale (yellow to orange); median areola spindle-shaped; anterior transverse carina of propodeum absent; median tergites entirely pale (yellow to orange).

Description. Holotype: female. Body length 4.8 mm. Fore wing length 4.5 mm. Fore wing mostly infuscated. Scutellar sulcus with one median longitudinal carina. Median areola of propodeum with sharp margins. Anterior transverse carina of propodeum absent. Lateral longitudinal carinae of median tergite 1 sharp. Median syntergite 2+3 1.3 times longer than wide. Ovipositor slightly longer than body.

Biology. Reared 12 times from 2 species of palm-feeding (*Geonoma, Chamaedorea*) Depressarriidae (*Stenoma* Janzen142 and *Stenoma* Janzen284) in the understory of ACG rain forest from 645 to 742 m.

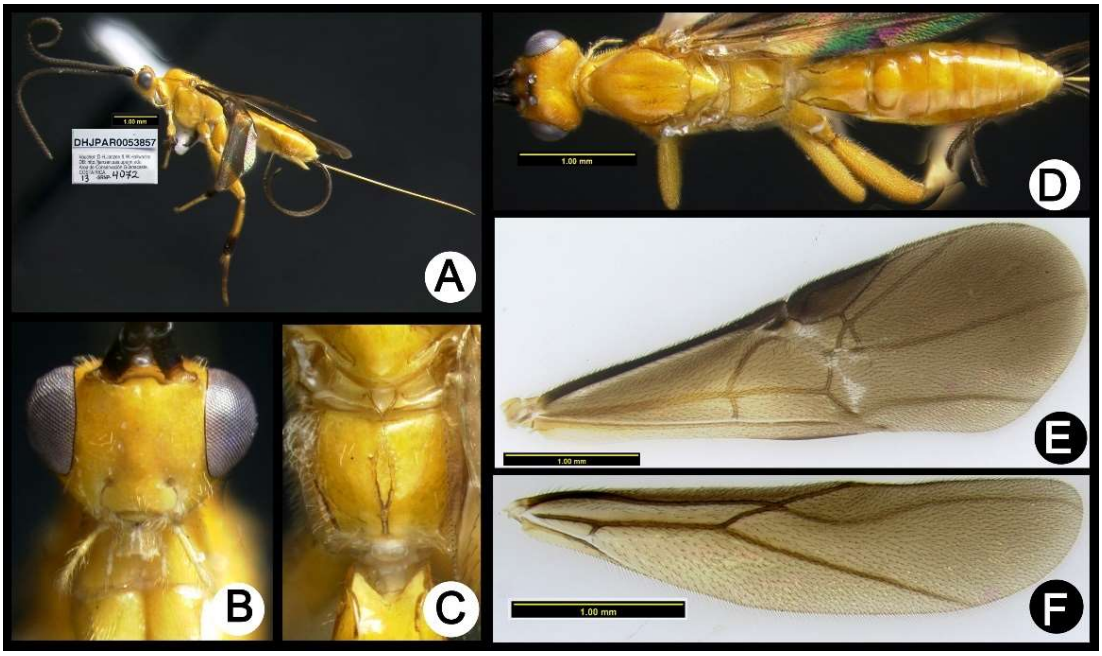


Plate 12. *Lytopylus gustavoindunii* holotype: A. lateral habitus, B. anterior head, C. propodeum, D. dorsal habitus, E. fore wing, F. hind wing.

Etymology. *Lytopylus gustavoindunii* is named in honor of Gustavo Induni in recognition of his participation in the collaborative development of the ICE-ACG geothermal project of Pailas II, north-western Costa Rica.

Material examined and distribution. Holotype ♀: Costa Rica, Alajuela, Sector San Cristobal, Sendero Perdido, Area de Conservación Guanacaste 10.8794N -85.38607W 620m., Elda Araya coll., food plant: Arecaceae *Geonoma ferruginea*, host caterpillar: Depressariidae, Stenomatinae, *Stenoma* Janzen284, coll. date: 8/9/2013, parasitoid eclosion date: 8/28/2013, DHJPAR0053857 13-SRNP-4072.

Paratypes: [the following have the same data as the holotype except as indicated] ♀, parasitoid eclosion date: 8/27/2013, DHJPAR0053648 13-SRNP-4070. ♀, parasitoid eclosion date: 8/31/2013, DHJPAR0053653 13-SRNP-4071. ♀, parasitoid eclosion date: 9/1/2013, DHJPAR0053646 13-SRNP-4073. ♀, Finca San Gabriel, 10.87766N -85.39343W 645m., host caterpillar: *Stenoma* Janzen142 coll. date: 11/16/2012, parasitoid eclosion date: 12/11/2012, DHJPAR0051369 12-SRNP-4947. [same as previous except eclosion date] ♀, parasitoid eclosion date: 12/20/2012, DHJPAR0051359 12-SRNP-4949. ♀, parasitoid eclosion date: 12/15/2012, DHJPAR0051372 12-SRNP-4951. ♀,

Sendero Aguas Termales, geolocation unknown, food plant: *Chamaedorea tepejilote*, host caterpillar: *Stenoma* Janzen142, coll. date: 10/10/2010, parasitoid eclosion date: 10/29/2010, DHJPAR0041560 10-SRNP-5859.

***Lytopylus hartmanguidoi* Kang n. sp.**

Diagnosis. Fore wing with one black band; mid tibia black basally and distally, yellow at mid-length.

Description. Holotype: female. Body length 4.3 mm. Fore wing length 4.3 mm. Fore wing with one black band. Scutellar sulcus with one median longitudinal carina. Median areola of propodeum with sharp margins. Anterior transverse carina of propodeum absent. Lateral longitudinal carinae of median tergite 1 sharp. Median syntergite 2+3 1.3 times longer than wide. Ovipositor longer than metasoma, but shorter than body.

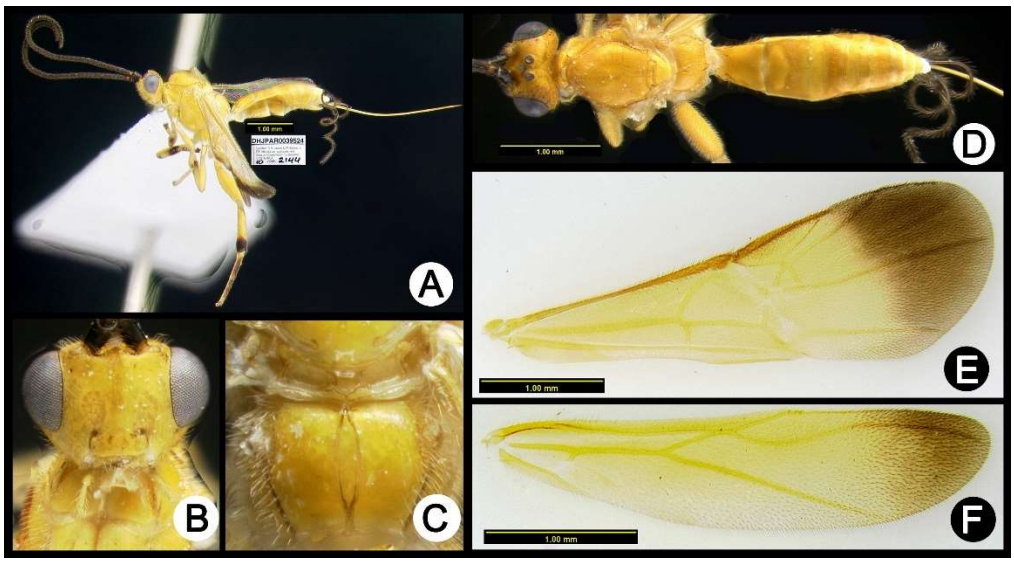


Plate 13. *Lytopylus hartmanguidoi* holotype: A. lateral habitus, B. anterior head, C. propodeum, D. dorsal habitus, E. fore wing, F. hind wing.

Biology. Reared 5 times from three species leaf-tiers in the Depressariidae, feeding on mature leaves of *Hiraea reclinata (*Malpighiaceae) at the intersection of the ACG dry forest and rain forest ecosystems at 540 m elevation.

Etymology. *Lytopylus hartmanguidoi* is named in honor of Hartman Guido in recognition of his participation in the collaborative development of the ICE-ACG geothermal project of Pailas II, north-western Costa Rica

Material examined and distribution. Holotype ♀: Costa Rica, Area de Conservación Guanacaste, Alajuela, Sector San Cristobal, Tajo Angeles, 10.86472N - 85.41531W 540m., Elda Araya coll., food plant: Malpighiaceae *Hiraea reclinata*, host caterpillar: Depressariidae, subfamily unknown, elachJanzen01 Janzen392, coll. date: 4/27/2010, parasitoid eclosion date: 5/19/2010, DHJPAR0039524 10-SRNP-2144.

Paratypes: [the following have the same data as the holotype except as indicated] ♀, Gloria Sihezar coll., host caterpillar: *Psilocorsis* Janzen369, coll. date: 4/20/2010, parasitoid eclosion date: 5/15/2010, DHJPAR0039513 10-SRNP-1992. ♀, Gloria Sihezar coll., parasitoid eclosion date: 6/4/2010, DHJPAR0039514 10-SRNP-2143. ♀, Gloria Sihezar host caterpillar: Depressariidae, Stenomatinae, *Antaeotricha* Janzen126. 1/10/2011 2/6/2011, DHJPAR0042831 11-SRNP-143. [same as previous except as coll. date and eclosion date] ♀, coll. date: 1/13/2011, parasitoid eclosion date: 2/8/2011, DHJPAR0042844 11-SRNP-166.

***Lytopylus hernanbravoi* Kang n. sp.**

Diagnosis. Fore wing mostly infuscated; hind coxa entirely black; mesoscutum entirely melanic; anterior transverse carina of propodeum reaching the lateral margin; median tergites entirely yellow.

Description. Holotype: male. Body length 6.0 mm. Fore wing length 6.7 mm. Fore wing mostly infuscated. Scutellar sulcus lacking longitudinal carina. Median areola of propodeum with sharp margins. Anterior transverse carina of propodeum reaching the lateral margin. Lateral longitudinal carinae of median tergite 1 sharp. Median syntergite 2+3 1.1 times longer than wide.

Biology. Reared one time from *Anadasmus* Janzen08 (Depressariidae), a stenomine leaf-tier feeding on mature foliage of *Ocotea austinii* (Lauraceae) in ACG cloud forest at 1460 m.

Etymology. *Lytopylus hernanbravoi* is named in honor of Hernan Bravo in recognition of his participation in the collaborative development of the ICE-ACG geothermal project of Pailas II, north-western Costa Rica.

Material examined and distribution. Holotype ♂: Costa Rica, Guanacaste, Sector Cacao, Sendero Cima, Area de Conservación Guanacaste 10.93328N -85.45729W 1460m., Harry Ramirez coll., food plant: Lauraceae *Ocotea austinii*, host caterpillar: Depressariidae, Stenomatinae, *Anadasmus* Janzen08, coll. date: 8/11/2008, parasitoid eclosion date: 9/6/2008, DHJPAR0028303 08-SRNP-36398.

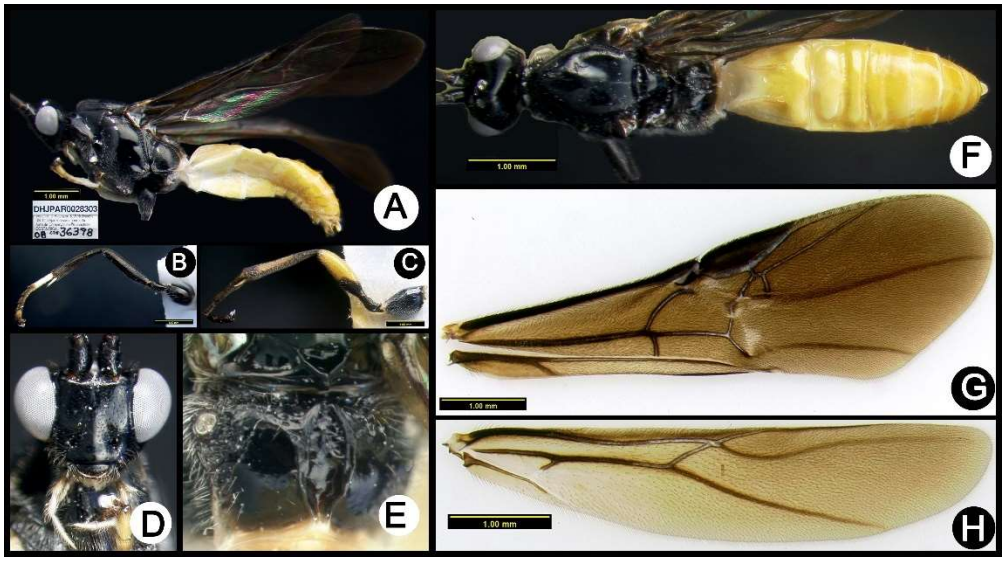


Plate 14. *Lytopylus hernanbravoi* holotype: A. lateral habitus, B. mid leg C. hind leg D. anterior head, E. propodeum, F. dorsal habitus, G. fore wing, H. hind wing.

Lytopylus hokwoni Kang n. sp.

Diagnosis. Fore wing with two black bands; pronotum entirely melanic; lateral longitudinal carinae of median tergite 1 sharp.

Description. Holotype: female. Body length 8.0 mm. Fore wing length 4.6 mm. Fore wing with two black bands. Scutellar sulcus with one median longitudinal carina. Anterior transverse carina of propodeum reaching the lateral margin. Median areola of propodeum with sharp margins. Lateral longitudinal carinae of median tergite 1 sharp. Median syntergite 2+3 1.6 times longer than wide. Ovipositor slightly longer than body.

Biology. Reared 9 times from 7 species of stenomatine Depressariidae feeding as leaf-tiers on 6 species of plants in 7 plant families at the intersection of the ACG dry forest and rain forest ecosystems at 280-640 m elevation.

Etymology. Named in honor of Hokwon Kang, father of the first author.

Material examined and distribution. Holotype ♀: Costa Rica, Guanacaste, Sector El Hacha, Estacion Los Almendros, Area de Conservación Guanacaste 11.03226N -85.52776W 290m., Elieth Cantillano coll., food plant: Clusiaceae *Clusia rosea*, host caterpillar: Depressariidae, Stenomatinae, *Stenoma* Janzen08, coll. date: 11/23/2011, parasitoid eclosion date: 12/10/2011, DHJPAR0048726 11-SRNP-23353.

Paratypes: [the following have the same data as the holotype except as indicated] ♂, 290m., Lucia Ríos coll., coll. date: 9/19/2008, parasitoid eclosion date: 10/6/2008, DHJPAR0030605 08-SRNP-23431. ♀, Sendero Bejuquilla, 11.03004N -85.52699W 280m., food plant: Piperaceae *Peperomia angularis*, host caterpillar: Depressariidae, subfamily and species name unknown, coll. date: 1/11/2010, parasitoid eclosion date: 2/5/2010, DHJPAR0037940 10-SRNP-20058. ♀, Sendero Bejuquilla, 11.03004N -85.52699W 280m., Dunia Garcia coll., food plant: Hypericaceae *Vismia baccifera*, host caterpillar: *Cerconota recurvella*, coll. date: 10/26/2002, parasitoid eclosion date: 11/13/2002, DHJPAR0015414 02-SRNP-31780. ♀, Sector Cacao, Cuesta Caimito, 10.8908N -85.47192W 640m., Mariano Pereira coll., food plant: Hypericaceae *Vismia baccifera*, host caterpillar: *Cerconota recurvella*, coll. date: 5/16/2004, parasitoid eclosion date: 5/30/2004, DHJPAR0029302 04-SRNP-45582. ♀, Sector Cacao, Quebrada Otilio, 10.88996N -85.47966W 550m., Daniel Garcia coll., food plant: Fabaceae *Inga punctate*, host caterpillar: *Antaeotricha* Phillips01, coll. date: 9/24/2007, parasitoid

eclosion date: 10/7/2007, DHJPAR0028279 07-SRNP-46312. ♀, Sector Pitilla, Cabrera, 11.00891N -85.40977W 500m., Calixto Moraga coll., food plant: Hypericaceae *Vismia baccifera*, host caterpillar: *Cerconota recurvella*, coll. date: 2/7/2007, parasitoid eclosion date: 2/14/2007, DHJPAR0017274 07-SRNP-31050. ♀, Alajuela, Sector Rincon Rain Forest, Sendero Tucan, 10.90424N -85.2712W 410m., Pablo Umaña Calderon coll., food plant: Melastomataceae *Miconia trinervia*, host caterpillar: elachJanzen01 Janzen211, coll. date: 4/7/2012, parasitoid eclosion date: 5/3/2012, DHJPAR0049051 12-SRNP-41437. ♀, Alajuela, Sector Rincon Rain Forest, Conguera, 10.91589N -85.26631W 420m., Jose Perez coll., food plant: Malpighiaceae *Banisteriopsis elegans*, host caterpillar: *Antaeotricha* Janzen127, coll. date: 5/17/2012, parasitoid eclosion date: 6/7/2012, DHJPAR0048714 12-SRNP-42246.

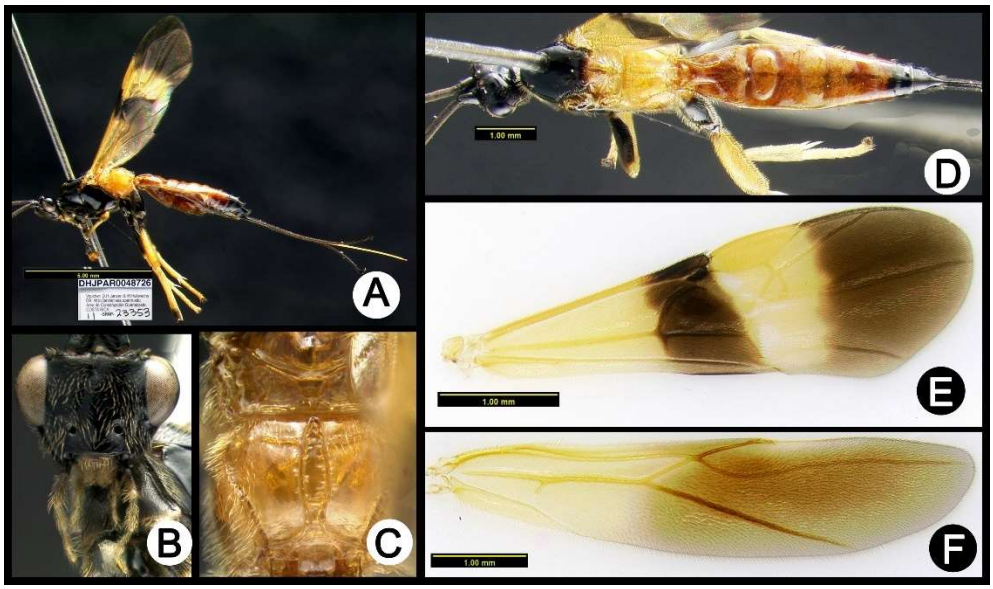


Plate 15. *Lytopylus hokwoni* holotype: A. lateral habitus, B. anterior head, C. propodeum, D. dorsal habitus, E. fore wing, F. hind wing.

Lytopylus ivanniasandovalae **Kang n. sp.**

Diagnosis. Fore wing with a slight yellow tinge; anterior transverse carina of propodeum absent; median tergites entirely pale.

Description. Holotype: male. Body length 5.8 mm. Fore wing length 5.0 mm. Fore wing with a slight yellow tinge. Scutellar sulcus with four longitudinal carinae. Median areola of propodeum with sharp margins. Anterior transverse carina of propodeum absent. Lateral longitudinal carinae of median tergite 1 sharp. Median syntergite 2+3 as long as wide.

Biology. Reared 1 time from *Dichomerus* Janzen703 (Dichomeridinae, Gelechiidae) tying and feeding on mature leaves of *Neurolaena lobata* (Asteraceae) in ACG rain forest at 660 m.

Etymology. *Lytopylus ivanniasandovalae* is named in honor of Ivannia Sandoval in recognition of her participation in the collaborative development of the ICE-ACG geothermal project of Pailas II, north-western Costa Rica.

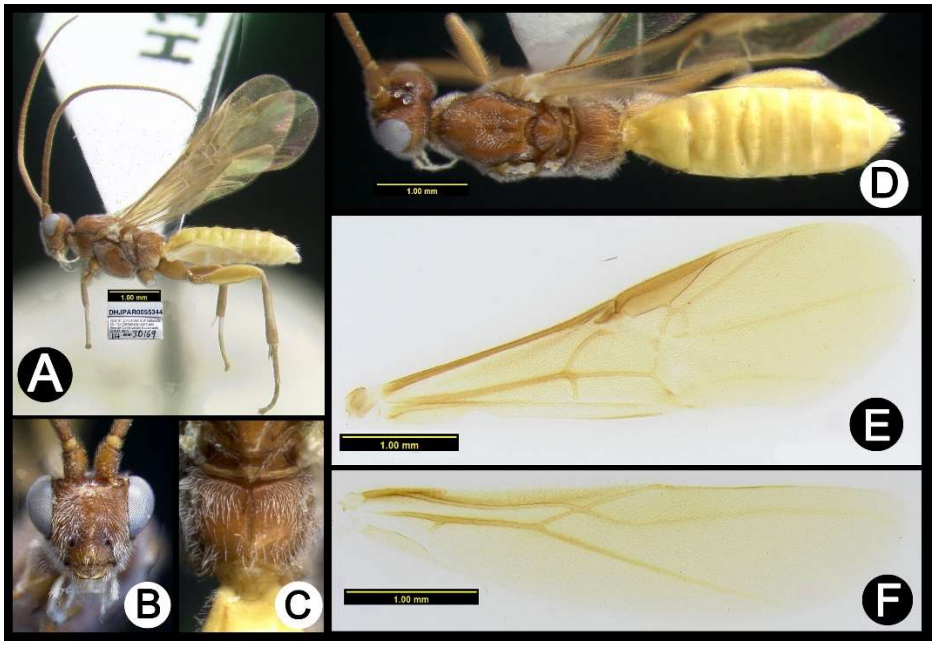


Plate 16. *Lytopylus ivanniasandovalae* holotype: A. lateral habitus, B. anterior head, C. propodeum, D. dorsal habitus, E. fore wing, F. hind wing.

Material examined and distribution. Holotype ♂: Costa Rica, Guanacaste, Sector Pitilla, Sendero Carica, Area de Conservación Guanacaste 10.99284N -85.42936W

660m., Calixto Moraga coll., food plant: Asteraceae *Neurolaena lobata*, host caterpillar: Gelechiidae, Dichomeridinae, *Dichomeris* Janzen703, coll. date: 1/25/2014, parasitoid eclosion date: 2/06/2014, DHJPAR0055344 14-SRNP-30169.

***Lytopylus johanvalerioi* Kang n. sp.**

Diagnosis. fore wing mostly infuscated; pronotum mostly yellow; mesoscutum mostly pale (yellow to orange); anterior transverse carina of propodeum reaching the lateral margin; median tergites mostly pale with posterior terga black.

Description. Holotype: female. Body length 4.9 mm. Fore wing length 4.6 mm. Fore wing mostly infuscated. Scutellar sulcus with one median longitudinal carina. Median areola of propodeum with sharp margins. Anterior transverse carina of propodeum reaching the lateral margin. Lateral longitudinal carinae of median tergite 1 sharp. Median syntergite 2+3 0.9 times longer than wide. Ovipositor longer than metasoma, but shorter than body.

Biology. Reared 6 times from two species of *Cerconota* leaf-tiers in the Depressariidae, feeding on mature leaves of three species of *Inga (*Fabaceae) in ACG rain forest at 540-645 m elevation.

Etymology. *Lytopylus johanvalerioi* is named in honor of Johan Valerio in recognition of his participation in the collaborative development of the ICE-ACG geothermal project of Pailas II, north-western Costa Rica.

Material examined and distribution. Holotype ♀: Costa Rica, Alajuela, Sector San Cristobal, Sendero Huerta, Area de Conservación Guanacaste 10.9305N -85.37223W 527m., Gloria Sihezar coll., food plant: Fabaceae Inga oerstediana, host caterpillar: Depressariidae, Stenomatinae, Cerconota Janzen82, coll. date: 5/25/2014, parasitoid eclosion date: 6/7/2014, DHJPAR0055354 14-SRNP-2639.

Paratypes: [the following have the same data as the holotype except as indicated] ♀, Brasilia, Moga, 11.01227N -85.34929W 320m., Duvalier Briceño coll., coll. date:

6/7/2012, parasitoid eclosion date: 6/19/2012, DHJPAR0049935 12-SRNP-65417. ♂, Guanacaste, Sector Pitilla, Estacion Quica, 10.99697N -85.39666W 470m., Ricardo Calero coll., food plant: Fabaceae Inga spectabilis, host caterpillar: Depressariidae, Stenomatinae, *Cerconota* Janzen216, coll. date: 5/25/2009, parasitoid eclosion date: 6/8/2009, DHJPAR0035498 09-SRNP-70554. [same as previous except coll. date and eclosion date] ♂, 5/27/2009 6/22/2009, DHJPAR0040066 09-SRNP-70603. ♂, Guanacaste, Sector Pitilla, Leonel, 10.99637N -85.40195W 510m., Mauricio Siezar coll., food plant: Inga spectabilis, host caterpillar: *Cerconota* Janzen216, coll. date: 6/15/2008, parasitoid eclosion date: 6/30/2008, DHJPAR0028298 08-SRNP-70822.

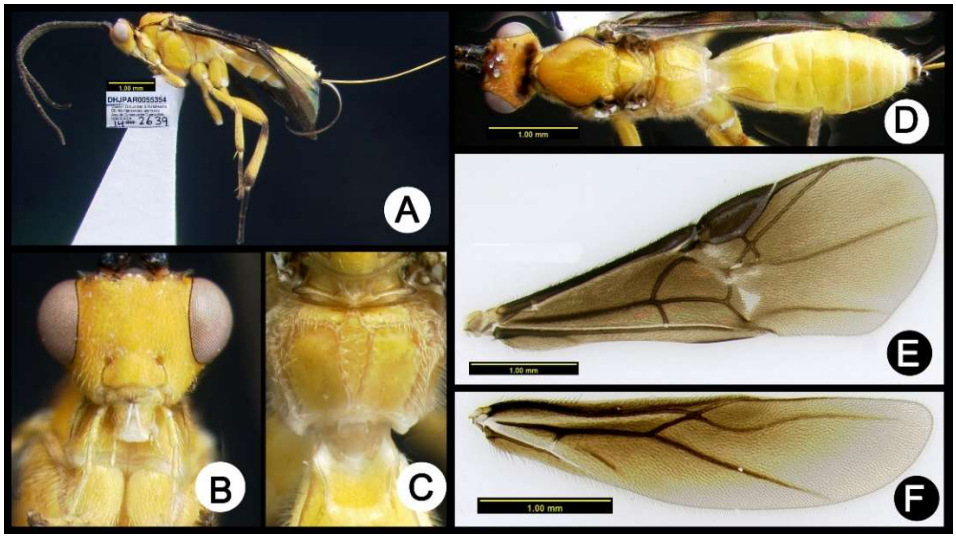


Plate 17. *Lytopylus johanvalerioi* holotype: A. lateral habitus, B. anterior head, C. propodeum, D. dorsal habitus, E. fore wing, F. hind wing.

Lytopylus josecortesi Kang n. sp.

Diagnosis. Fore wing mostly infuscated; mesoscutum entirely melanic; anterior transverse carina of propodeum absent; median areola of propodeum spindle-shape; lateral longitudinal carinae of median tergite 1 sharp; median tergites entirely reddish orange.

Description. Holotype: female. Body length 5.2 mm. Fore wing length 5.3 mm. Fore wing mostly infuscated. Scutellar sulcus with three longitudinal carinae. Median areola of propodeum with sharp margins. Anterior transverse carina of propodeum absent. Lateral longitudinal carinae of median tergite 1 sharp. Median syntergite 2+3 1.1 times longer than wide. Ovipositor longer than metasoma, but shorter than body.

Biology. Reared 2 times from *Dichomeris* Janzen703 (Dichomeridinae, Gelechiidae) feeding on mature leaves of *Neurolaena lobata* (Asteraceae) in ACG dry forest – rain forest ecotone at 620 m.

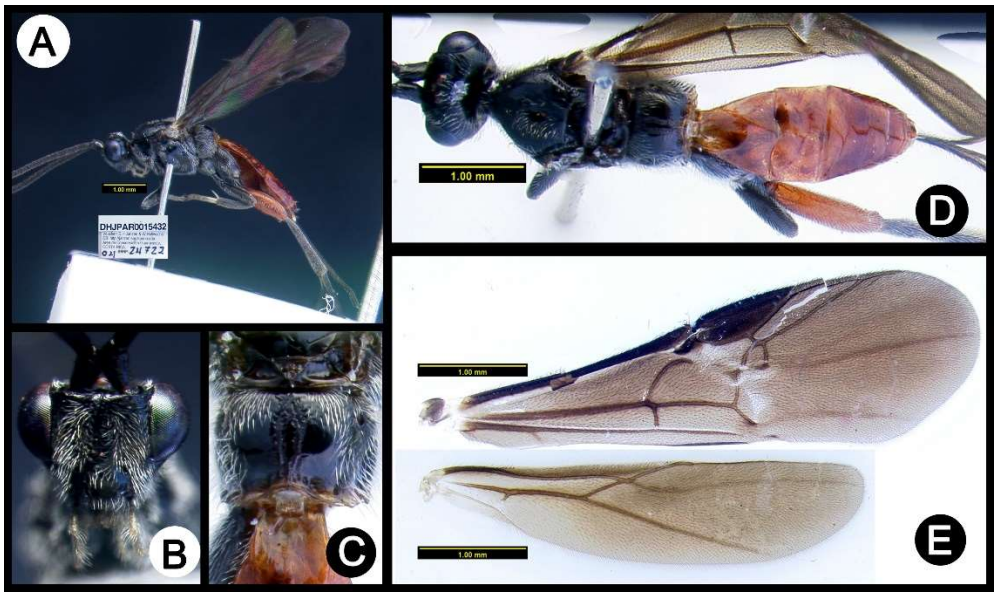


Plate 18. *Lytopylus josecortesi* holotype: A. lateral habitus, B. anterior head, C. propodeum, D. dorsal habitus, E. fore wing, F. hind wing.

Etymology. *Lytopylus josecortesi* is named in honor of Jose Cortes in recognition of his participation in the collaborative development of the ICE-ACG geothermal project of Pailas II, north-western Costa Rica.

Material examined and distribution. Holotype ♀: Costa Rica, Guanacaste, Sector Del Oro, Bosque Aguirre, Area de Conservación Guanacaste 11.0006N -85.438W 620m., Elieth Cantillano coll., food plant: Asteraceae *Neurolaena lobata*, host caterpillar:

Gelechiidae, Dichomeridinae, *Dichomeris* Janzen703, coll. date: 9/21/2004, parasitoid eclosion date: 10/3/2004, DHJPAR0015432 04-SRNP-24722.

Paratype: [the following have the same data as the holotype except as indicated] ♂, parasitoid eclosion date: 10/13/2004, DHJPAR0015431 04-SRNP-24720.

***Lytopylus luisgaritai* Kang n. sp.**

Diagnosis. Fore wing mostly infuscated; pronotum mostly pale, anteriorly melanic; mesoscutum entirely pale; mesopleuron entirely orange; scutellar sulcus lacking longitudinal carina; median tergites mostly melanic.

Description. Holotype: female. Body length 6.7 mm. Fore wing length 6.3 mm. Fore wing mostly infuscated. Scutellar sulcus lacking longitudinal carina. Median areola of propodeum with sharp margins. Anterior transverse carina of propodeum reaching the lateral margin. Lateral longitudinal carinae of median tergite 1 sharp. Median syntergite 2+3 as long as wide. Ovipositor longer than metasoma, but shorter than body.

Biology. Reared 2 times from *Oecophora* Janzen52 (Oecophorinae, Oecophoridae) feeding on mature leaves of *Clethra lanata* (Clethraceae) in ACG dry forest at 733-740 m.

Etymology. *Lytopylus luisgaritai* is named in honor of Luis Garita in recognition of his participation in the collaborative development of the ICE-ACG geothermal project of Pailas II, north-western Costa Rica.

Material examined and distribution. Holotype ♀: Costa Rica, Guanacaste, Sector Mundo Nuevo, Camino Pozo Tres, Area de Conservación Guanacaste 10.77079N -85.37422W 733m., Jose Cortez coll., food plant: Clethraceae *Clethra lanata*, host caterpillar: Depressariidae, Oecophorinae, *Oecophora* Janzen52, coll. date: 1/22/2012, parasitoid eclosion date: 3/3/2012, DHJPAR0049053 12-SRNP-55132.

Paratype: [the following have the same data as the holotype except as indicated] ♀, Cerro Gongora Pelado, 10.76307N -85.41332W 740m., coll. date: 1/18/2014, parasitoid eclosion date: 2/22/2014, DHJPAR0055239 14-SRNP-55220.

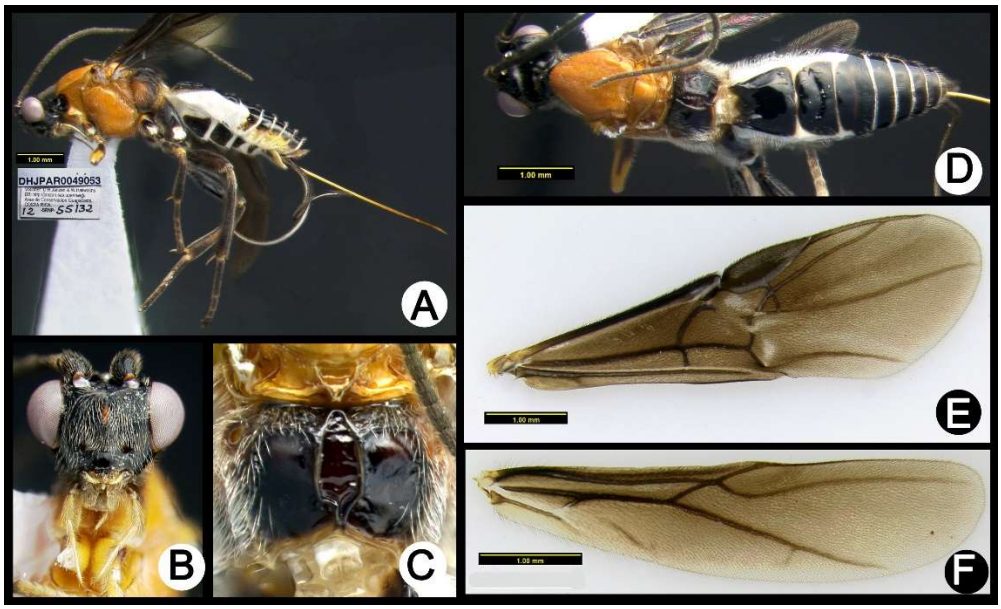


Plate 19. *Lytopylus luisgaritai* holotype: A. lateral habitus, B. anterior head, C. propodeum, D. dorsal habitus, E. fore wing, F. hind wing.

***Lytopylus mariamartachavarriae* Kang n. sp.**

Diagnosis. Fore wing hyaline; fore wing RS+Ma 50% complete; anterior transverse carina of propodeum reaching the lateral margin; median tergites entirely pale.

Description. Holotype: female. Body length 4.4 mm. Fore wing length 4.0 mm. Fore wing hyaline. Scutellar sulcus with three longitudinal carinae. Median areola of propodeum with sharp margins. Anterior transverse carina of propodeum reaching the lateral margin. Lateral longitudinal carinae of median tergite 1 sharp. Median syntergite 2+3 0.9 times longer than wide. Ovipositor longer than metasoma, but shorter than body.

Biology. Reared 4 times from *Dichomeris santarosensis* (Dichomeridinae, Gelechiidae) feeding on new leaves of *Quercus oleoides* (Fagaceae) in ACG dry forest at 305 m.

Etymology. *Lytopylus mariamartachavarriae* is named in honor of Maria Marta Chavarria in recognition of her participation in the collaborative development of the ICE-ACG geothermal project of Pailas II, north-western Costa Rica.

Material examined and distribution. Holotype ♀: Costa Rica, Guanacaste, Sector Santa Rosa, Arboles Via, Area de Conservación Guanacaste 10.86081N -85.60828W 305m., Daniel H. Janzen coll., food plant: Fagaceae *Quercus oleoides*, host caterpillar: Gelechiidae, Dichomeridinae, *Dichomeris santarosensis*, coll. date: 6/24/1982, eclosion date unknown, DHJPAR0015502 82-SRNP-311.3.

Paratypes: [the following have the same data as the holotype except as indicated] 2♀, 1♂, DHJPAR0015501 82-SRNP-311.2, DHJPAR0015503 82-SRNP-311.4, DHJPAR0015500 82-SRNP-311.5.

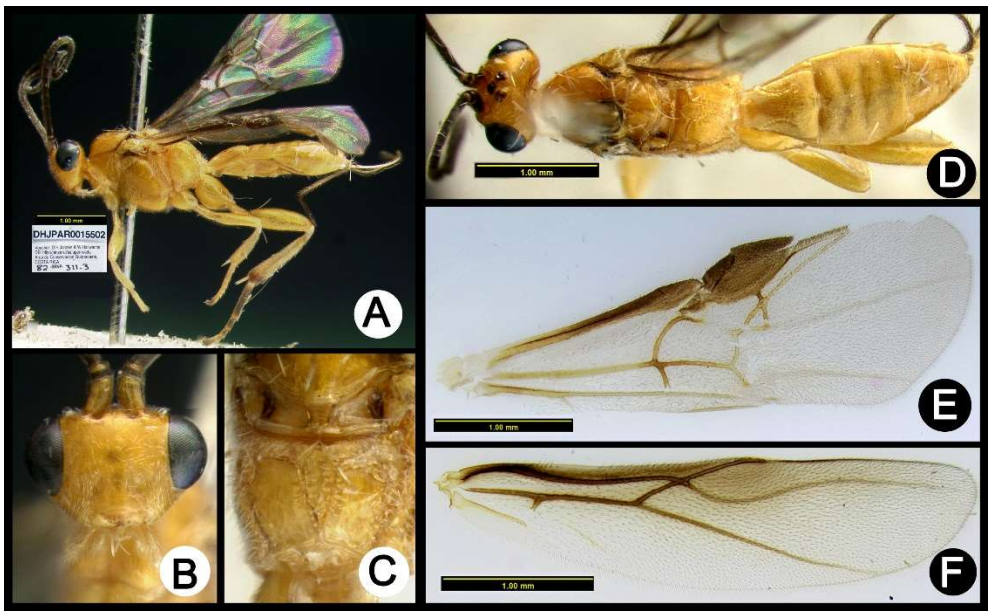


Plate 20. *Lytopylus mariamartachavarriae* holotype: A. lateral habitus, B. anterior head, C. propodeum, D. dorsal habitus, E. fore wing, F. hind wing.

Lytopylus miguelviquezi Kang n. sp.

Diagnosis. Apical flagellomeres brown not distinctly paler than subapical flagellomeres; fore wing mostly infuscated with a triangular second submarginal cell;

fore tibia mostly melanic, yellow basally; hind tibia black basally and distally, yellow at mid-length; pronotum entirely pale (yellow to orange); mesoscutum entirely pale (yellow to orange); median areola of propodeum kite-shaped; anterior transverse carina of propodeum not reaching the lateral margin; median tergites mostly pale with posterior terga black; median syntergite 2+3 1.1 times longer than wide.

Description. Holotype: female. Body length 5.1 mm. Fore wing length 4.9 mm. Fore wing mostly infuscated. Scutellar sulcus with one median longitudinal carina. Median areola of propodeum with sharp margins. Anterior transverse carina of propodeum not reaching the lateral margin. Lateral longitudinal carinae of median tergite 1 sharp. Median syntergite 2+3 1.1 times longer than wide. Ovipositor longer than metasoma, but shorter than body.

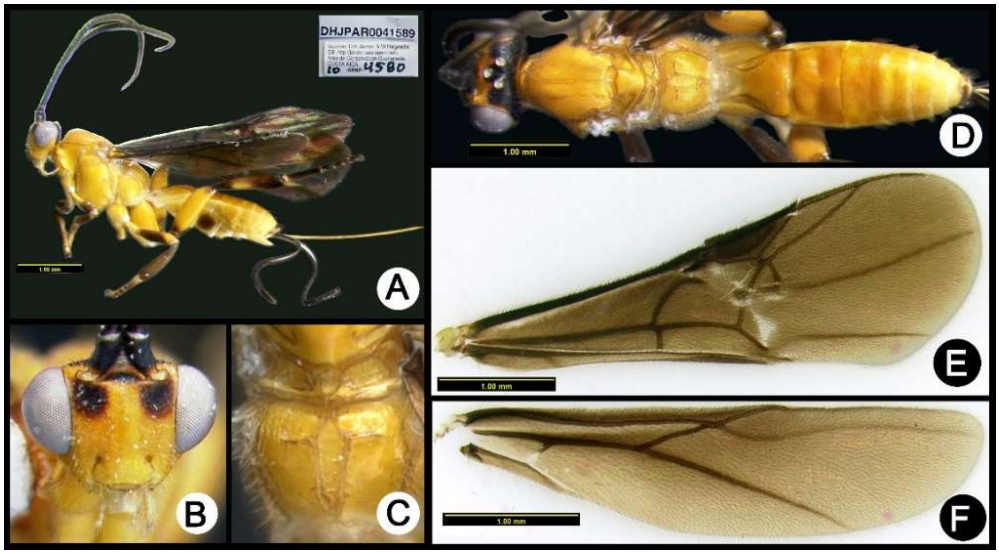


Plate 21. *Lytopylus miguelviquezi* holotype: A. lateral habitus, B. anterior head, C. propodeum, D. dorsal habitus, E. fore wing, F. hind wing.

Biology. Reared 58 times from the *Dichomeris designatella* complex (21), gelJanzen01 Janzen179 (13), and gelJanzen01 Janzen485 (16), all leaf tying dichomeridine Gelechiidae feeding on mature leaves of 2 species of *Erythroxylum* (Erythroxylaceae) and 2 species of *Rinorea* (Violaceae) in ACG rain forest-dry forest ecotone, and rain forest at 109-540 m.

Etymology. *Lytopylus miguelviquezi* is named in honor of Miguel Viquez in recognition of his participation in the collaborative development of the ICE-ACG geothermal project of Pailas II, north-western Costa Rica.

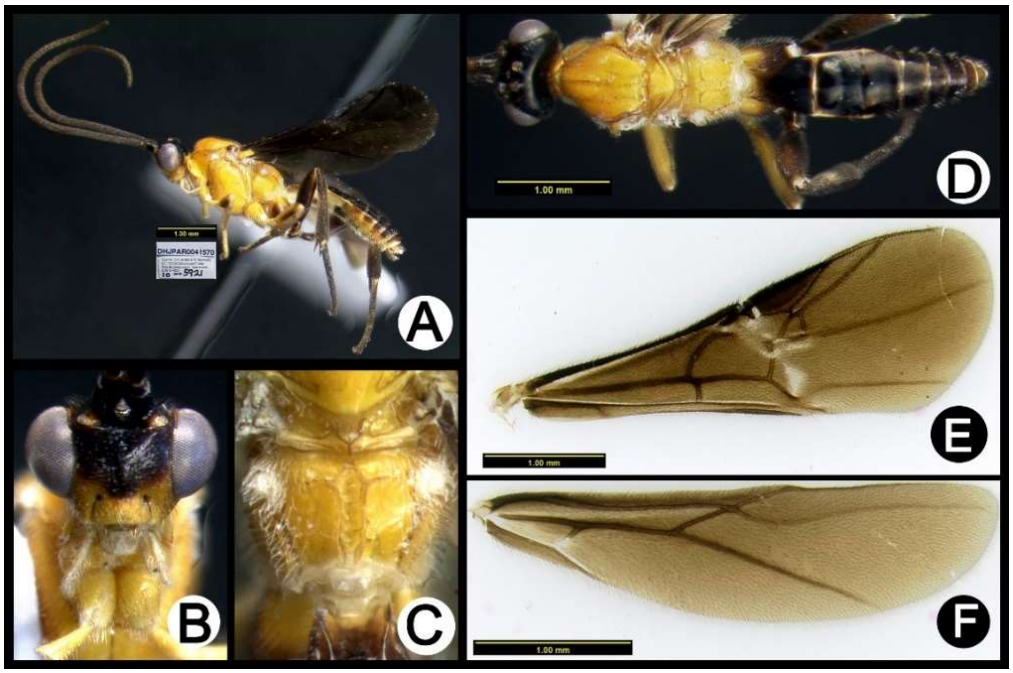


Plate 22. *Lytopylus miguelviquezi* male: A. lateral habitus, B. anterior head, C. propodeum, D. dorsal habitus, E. fore wing, F. hind wing.

Material examined and distribution. Holotype ♀: Costa Rica, Alajuela, Sector San Cristobal, Tajo Angeles, Area de Conservación Guanacaste 10.86472N -85.41531W 540m., Carolina Cano coll., food plant: Erythroxylaceae *Erythroxylum macrophyllum*, host caterpillar: Gelechiidae, Dichomeridinae, *Dichomeris* designatellaDHJ02, coll. date: 8/19/2010, parasitoid eclosion date: 9/8/2010, DHJPAR0041589 10-SRNP-4580.

Paratypes: [the following have the same data as the holotype except as indicated] ♂, host caterpillar: *Dichomeris* designatellaDHJ03, coll. date: 1/25/2011, parasitoid eclosion date: 2/17/2011, DHJPAR0043147 11-SRNP-451. ♀, coll. date: 7/8/2010, parasitoid eclosion date: 7/24/2010, DHJPAR0040341 10-SRNP-3667. ♀, coll. date: 7/8/2010, parasitoid eclosion date: 7/26/2010, DHJPAR0040347 10-SRNP-3668. ♀, food plant: Violaceae *Rinorea squamata*, host caterpillar: gelJanzen01 Janzen485, coll. date: 6/10/2010, parasitoid eclosion date: 6/26/2010, DHJPAR0040336 10-SRNP-2952. [same

as previous except coll. date and eclosion date] ♀, coll. date: 10/15/2010, parasitoid eclosion date: 11/2/2010, DHJPAR0041566 10-SRNP-5920. ♂, coll. date: 10/15/2010, parasitoid eclosion date: 10/30/2010, DHJPAR0041570 10-SRNP-5921. ♂, coll. date: 10/15/2010, parasitoid eclosion date: 10/27/2010, DHJPAR0041565 10-SRNP-5922. ♂, coll. date: 10/20/2010, parasitoid eclosion date: 11/7/2010, DHJPAR0041567 10-SRNP-6122. ♂, coll. date: 11/7/2010, parasitoid eclosion date: 11/25/2010, DHJPAR0041555 10-SRNP-6619. ♂, coll. date: 11/7/2010, parasitoid eclosion date: 11/24/2010, DHJPAR0041553 10-SRNP-6620. ♀, Elda Araya coll., coll. date: 3/4/2010, parasitoid eclosion date: 4/6/2010, DHJPAR0038911 10-SRNP-1117. [same as previous except coll. date and eclosion date] ♀, coll. date: 3/4/2010, parasitoid eclosion date: 3/21/2010, DHJPAR0038920 10-SRNP-1122. ♀, coll. date: 3/4/2010, parasitoid eclosion date: 3/26/2010, DHJPAR0038918 10-SRNP-1123. ♀, coll. date: 3/4/2010, parasitoid eclosion date: 3/25/2010, DHJPAR0038906 10-SRNP-1124. ♀, coll. date: 3/4/2010, parasitoid eclosion date: 3/26/2010, DHJPAR0038912 10-SRNP-1126. ♀, coll. date: 3/4/2010, parasitoid eclosion date: 3/26/2010, DHJPAR0038916 10-SRNP-1130. ♀, coll. date: 6/25/2010, parasitoid eclosion date: 7/11/2010, DHJPAR0040340 10-SRNP-3383. ♀, coll. date: 10/25/2010, parasitoid eclosion date: 11/14/2010, DHJPAR0041575 10-SRNP-6250. ♀, food plant: Violaceae *Rinorea squamata*, host caterpillar: gelJanzen01 Janzen485, coll. date: 3/7/2010, parasitoid eclosion date: 3/24/2010, DHJPAR0038909 10-SRNP-1261. [same as previous except coll. date and eclosion date] ♀, coll. date: 6/10/2010, parasitoid eclosion date: 6/30/2010, DHJPAR0040502 10-SRNP-2940. ♀, coll. date: 10/19/2010, parasitoid eclosion date: 11/10/2010, DHJPAR0041563 10-SRNP-6080. ♀, host caterpillar: gelJanzen01 Janzen179, 5/6/2011 6/23/2011, DHJPAR0045296 11-SRNP-2222. [same as previous except and eclosion date] ♂, 5/6/2011 6/22/2011, DHJPAR0045305 11-SRNP-2223. ♀, parasitoid eclosion date: 6/20/2011, DHJPAR0045373 11-SRNP-2224. ♀, parasitoid eclosion date: 6/22/2011, DHJPAR0045371 11-SRNP-2227. ♀, parasitoid eclosion date: 6/20/2011, DHJPAR0045276 11-SRNP-2228. ♀, parasitoid eclosion date: 6/19/2011, DHJPAR0045372 11-SRNP-2230. ♀, parasitoid eclosion date: 6/25/2011, DHJPAR0045369 11-SRNP-2232. ♀, parasitoid eclosion date: 6/22/2011, DHJPAR0045368 11-SRNP-2234. [same as previous except food plant and eclosion

date] ♂, food plant: *Rinorea deflexiflora*, coll. date: 6/4/2014, parasitoid eclosion date: 6/17/2014, DHJPAR0055506 14-SRNP-2742. ♀, Gloria Sihezar coll., coll. date: 6/25/2010, parasitoid eclosion date: 7/20/2010, DHJPAR0040327 10-SRNP-3379. [same as previous except coll. date and eclosion date] ♀, coll. date: 7/8/2010, parasitoid eclosion date: 7/30/2010, DHJPAR0040332 10-SRNP-3673. ♀, coll. date: 11/1/2010, parasitoid eclosion date: 11/25/2010, DHJPAR0041561 10-SRNP-6397. ♂, host caterpillar: *Dichomeris* designatellaDHJ03, coll date: 7/26/2010, parasitoid eclosion date: 8/8/2010, DHJPAR0040330 10-SRNP-4072. [same as previous except eclosion date] ♂, parasitoid eclosion date: 8/13/2010, DHJPAR0040474 10-SRNP-4073. ♂, parasitoid eclosion date: 8/12/2010, DHJPAR0040459 10-SRNP-4074. ♂, parasitoid eclosion date: 8/11/2010, DHJPAR0040348 10-SRNP-4075. ♀, parasitoid eclosion date: 8/13/2010, DHJPAR0040342 10-SRNP-4076. ♂, parasitoid eclosion date: 8/13/2010, DHJPAR0040483 10-SRNP-4077. ♂, parasitoid eclosion date: 8/17/2010, DHJPAR0041588 10-SRNP-4078. ♀, host caterpillar: *Dichomeris* designatellaDHJ02, coll. date: 9/28/2010, parasitoid eclosion date: 10/25/2010, DHJPAR0041592 10-SRNP-5639. [same as previous except coll. date and eclosion date] ♀, coll. date: 3/14/2010, parasitoid eclosion date: 3/29/2010, DHJPAR0038917 10-SRNP-1505. [same as previous except as indicated] ♂, food plant: Violaceae *Rinorea squamata*, host caterpillar: gelJanzen01 Janzen485, coll. date: 5/24/2010, parasitoid eclosion date: 6/7/2010, DHJPAR0039509 10-SRNP-2599. [same as previous except coll. date and eclosion date] ♂, coll. date: 5/24/2010, parasitoid eclosion date: 6/7/2010, DHJPAR0039516 10-SRNP-2603. ♂, coll. date: 5/24/2010, parasitoid eclosion date: 6/8/2010, DHJPAR0039508 10-SRNP-2606. ♀, coll. date: 10/30/2010, parasitoid eclosion date: 11/27/2010, DHJPAR0041574 10-SRNP-6319. ♀, Gloria Sihezar coll., food plant: Erythroxylaceae *Erythroxylum havanense*, coll. date: 6/25/2010, parasitoid eclosion date: 7/10/2010, DHJPAR0040326 10-SRNP-3385. [same as previous except as indicated] ♀, food plant: *Erythroxylum macrophyllum*, host caterpillar: *Dichomeris* designatellaDHJ02, coll. date: 2/9/2011, parasitoid eclosion date: 3/1/2011, DHJPAR0042843 11-SRNP-538. ♀, Osvaldo Espinoza coll., food plant: Violaceae *Rinorea squamata*, host caterpillar: gelJanzen01 Janzen179, coll. date: 2/9/2011, parasitoid eclosion date: 2/26/2011, DHJPAR0042842 11-SRNP-534. ♂, Osvaldo Espinoza coll., coll. date: 8/29/2010,

parasitoid eclosion date: 9/12/2010, DHJPAR0041597 10-SRNP-4858. ♀, Rio Blanco Abajo, 10.90037N -85.37254W 500m., Gloria Sihezar coll., food plant: Violaceae *Rinorea squamata*, host caterpillar: gelJanzen01 Janzen179, coll. date: 6/9/2011, parasitoid eclosion date: 6/24/2011, DHJPAR0045374 11-SRNP-2297. ♂, Sector Rincon Rain Forest, Sendero Anonas, 10.90528N -85.27882W 405m., Anabelle Cordoba coll., food plant: Violaceae *Rinorea hummelii*, host caterpillar: gelJanzen01 Janzen485, coll. date: 5/20/2014, parasitoid eclosion date: 6/10/2014, DHJPAR0055484 14-SRNP-42493. ♀, Sector Rincon Rain Forest, Quebrada Bambu, 10.9301N -85.25205W 109m., Cirilo Umaña coll., food plant: Violaceae *Rinorea deflexiflora*, host caterpillar: gelJanzen01 Janzen179, coll. date: 5/29/2014, parasitoid eclosion date: 6/10/2014, DHJPAR0055562 14-SRNP-76021. ♀, Guanacaste, Sector Del Oro, Quebrada Raiz, 11.02865N -85.48669W 280m., Roster Moraga coll., food plant: Violaceae *Rinorea deflexiflora*, host caterpillar: gelJanzen01 Janzen485, coll. date 6/3/2005, parasitoid eclosion date: 5/21/2005, DHJPAR0015528 05-SRNP-21835. ♀, Guanacaste, Sector Del Oro, Canyon Rio Mena, 10.99616N -85.45562W 560m., Lucia Ríos coll., coll. date: 3/26/2009, parasitoid eclosion date: 5/3/2009, DHJPAR0037860 09-SRNP-20936. ♂, Guanacaste, Sector Del Oro, Meteorologico, 11.00199N -85.46166W 590m., Lucia Ríos coll., coll. date: 9/3/2010, parasitoid closion date: 9/21/2010, DHJPAR0041949 10-SRNP-21996.

***Lytopylus motohasegawai* Kang n. sp.**

Diagnosis. Vertex of head entirely yellow; fore wing mostly infuscated with a quadrate second submarginal cell; mesoscutum mostly or entirely pale (yellow to orange); median areola of propodeum kite-shaped; anterior transverse carina of propodeum not reaching the lateral margin; median tergites entirely pale (yellow to orange).

Description. Holotype: female. Body length 4.9 mm. Fore wing length 4.9 mm. Fore wing mostly infuscated. Scutellar sulcus with one median longitudinal carina. Median areola of propodeum with sharp margins. Anterior transverse carina of propodeum not reaching the lateral margin. Lateral longitudinal carinae of median tergite 1 sharp.

Median syntergite 2+3 as long as wide. Ovipositor longer than metasoma, but shorter than body.

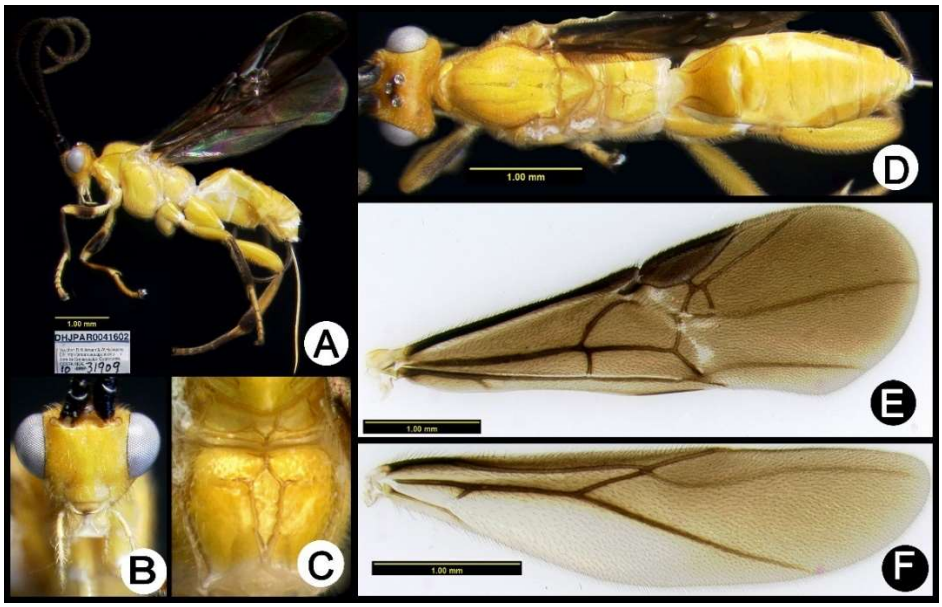


Plate 23. *Lytopylus motohasegawai,* holotype: A. lateral habitus, B. anterior head, C. propodeum, D. dorsal habitus, E. fore wing, F. hind wing.

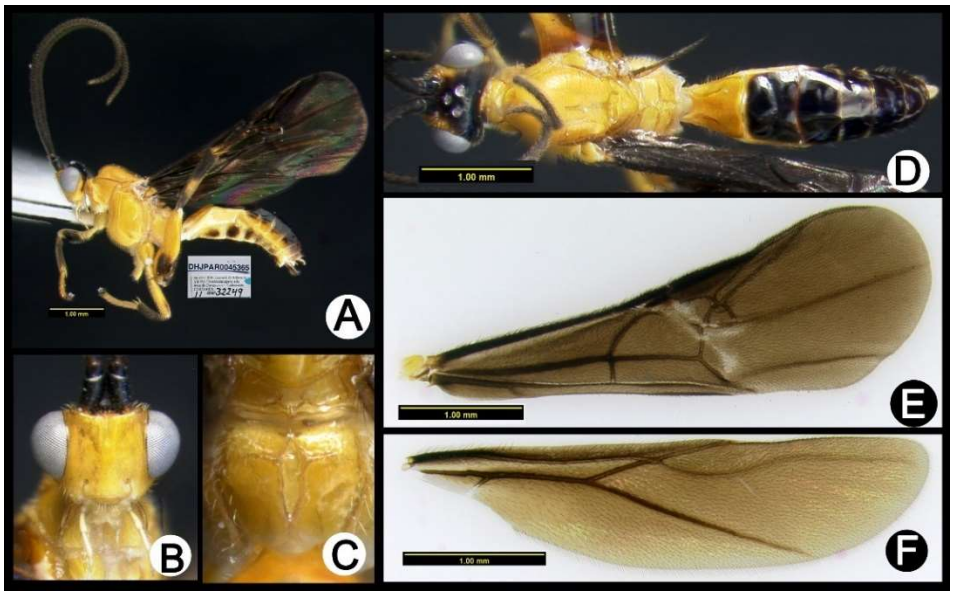


Plate 24. *Lytopylus motohasegawai* male: A. lateral habitus, B. anterior head, C. propodeum, D. dorsal habitus, E. fore wing, F. hind wing.

Biology. Reared 36 times from gelJanzen01 Janzen28, a leaf-tier in the Gelechiidae feeding on mature leaves of 2 species of *Roupala* (Proteaceae) in ACG rain forest at 415-740 m elevation.

Etymology. *Lytopylus motohasegawai* is named in honor of Motohiro Hasegawa in recognition of his participation in the collaborative development of the ICE-ACG geothermal project of Pailas II, north-western Costa Rica.

Material examined and distribution. Holotype ♀: Costa Rica, Guanacaste, Sector Pitilla, Sendero Naciente, Area de Conservación Guanacaste 10.98705N -85.42816W 700m., Manuel Rios coll., food plant: Proteaceae *Roupala glaberrima*, host caterpillar: Gelechiidae, subfamily unknown, gelJanzen01 Janzen28, coll. date: 8/30/2010, parasitoid eclosion date: 9/23/2010, DHJPAR0041602 10-SRNP-31909.

Paratypes: [the following have the same data as the holotype except as indicated] ♀, coll. date: 10/13/2010, parasitoid eclosion date: 11/1/2010, DHJPAR0041962 10-SRNP-32198. ♀, coll. date: 8/6/2011, parasitoid eclosion date: 9/10/2011, DHJPAR0048071 11-SRNP-32185. ♀, parasitoid eclosion date: 8/29/2011, DHJPAR0045318 11-SRNP-32186. ♂, parasitoid eclosion date: 9/8/2011, DHJPAR0048064 11-SRNP-32187. ♀, parasitoid eclosion date: 9/8/2011, DHJPAR0048068 11-SRNP-32188. ♀, Petrona Rios coll., parasitoid eclosion date: 8/31/2011, DHJPAR0048067 11-SRNP-32172. [same as previous except eclosion date] ♂, parasitoid eclosion date: 8/29/2011, DHJPAR0045364 11-SRNP-32173. ♂, Calixto Moraga coll., coll. date: 8/9/2011, parasitoid eclosion date: 8/29/2011, DHJPAR0045365 11-SRNP-32249. [same as previous except coll. date and eclosion date] ♀, coll. date: 1/17/2011, parasitoid eclosion date: 2/21/2011, DHJPAR0042463 11-SRNP-30250. ♀, Sendero Memos, 10.98171N -85.42785W 740m., Petrona Rios coll., coll. date: 8/8/2011, parasitoid eclosion date: 9/18/2011, DHJPAR0048065 11-SRNP-32255. [same as previous except eclosion date] ♀, parasitoid eclosion date: 9/9/2011, DHJPAR0048063 11-SRNP-32256. ♀, parsitoids eclosion date: 9/10/2011, DHJPAR0048066 11-SRNP-32257. ♀, Sendero Nacho, 10.98445N -85.42481W 710m., Petrona Rios coll., coll. date: 8/24/2010, parasitoid eclosion date: 10/1/2010, DHJPAR0041601 10-SRNP-31962. [same as previous except as indicated] ♀,

Manuel Rios coll., coll. date: 9/27/2010, parasitoid eclosion date: 10/21/2010, DHJPAR0041203 10-SRNP-32097. [same as previous except eclosion date] ♂, parasitoid eclosion date: 11/2/2010, DHJPAR0041960 10-SRNP-32170. ♀, parasitoid eclosion date: 11/3/2010, DHJPAR0041963 10-SRNP-32171. ♂, parasitoid eclosion date: 10/28/2010, DHJPAR0041954 10-SRNP-32172. ♂, Manguera, 10.9959N -85.39842W 470m., Manuel Rios coll., coll. date: 1/4/2011, parasitoid eclosion date: 1/29/2011, DHJPAR0041577 11-SRNP-70053. [same as previous except as indicated] ♀, Ricardo Calero coll., coll. date: 7/15/2011, parasitoid eclosion date: 8/6/2011, DHJPAR0045330 11-SRNP-71543. [same as previous except eclosion date] ♀, parasitoid eclosion date: 9/12/2011, DHJPAR0048062 11-SRNP-71689. ♀, parasitoid eclosion date: 9/13/2011, DHJPAR0048061 11-SRNP-71690. ♀, parasitoid eclosion date: 9/13/2011, DHJPAR0048059 11-SRNP-71691. [same as previous except coll. date and eclosion date] ♀, coll. date: 9/11/2011 parasitoid eclosion date: 9/29/2011, DHJPAR0048060 11-SRNP-72067. ♂, coll. date: 9/18/2011 parasitoid eclosion date: 10/20/2011, DHJPAR0048073 11-SRNP-72082. ♀, coll. date: 9/18/2011 parasitoid eclosion date: 10/24/2011, DHJPAR0048072 11-SRNP-72083. ♀, Sendero Cuestona, 10.99455N -85.41461W 640m., Freddy Quesada coll., coll. date: 8/25/2011, parasitoid eclosion date: 9/14/2011, DHJPAR0048070 11-SRNP-32424. ♀, Alajuela, Sector San Cristobal, Tajo Angeles, 10.86472N -85.41531W 540m., Elda Araya coll., food plant: Proteaceae *Roupala montana*, coll. date: 10/9/2010, parasitoid eclosion date: 10/30/2010, DHJPAR0041573 10-SRNP-5811. [same as previous except coll. date and eclosion date] ♀, coll. date: 10/23/2010, parasitoid eclosion date: 11/12/2010, DHJPAR0041568 10-SRNP-6183. ♀, coll. date: 10/23/2010, parasitoid eclosion date: 12/3/2010, DHJPAR0041564 10-SRNP-6185. ♀, coll. date: 12/22/2010, parasitoid eclosion date: 1/28/2011, DHJPAR0041584 10-SRNP-7456. ♂, Sector Rincon Rain Forest, Jacobo, 10.94076N -85.3177W 461m, Edwin Apu coll., food plant: Proteaceae *Roupala glaberrima*, coll. date: 1/18/2014, parasitoid eclosion date: 2/6/2014, DHJPAR0054745 14-SRNP-80067. ♀, Estacion Caribe, 10.90187N -85.27495W 415m., Pablo Umaña Calderon coll., food plant: Proteaceae *Roupala montana*, coll. date: 7/31/2009, parasitoid eclosion date: 8/19/2009, DHJPAR0040071 09-SRNP-42043.

***Lytopylus okchunae* Kang n. sp.**

Diagnosis. Apical flagellomeres brown not distinctly paler than subapical flagellomeres; vertex of head entirely melanic; fore wing mostly infuscated; mesoscutum entirely orange; anterior transverse carina of propodeum absent; median tergites entirely orange; median syntergite 2+3 1.5 times longer than wide.

Description. Holotype: female. Body length 6.8 mm. Fore wing length 6.3 mm. Fore wing mostly infuscated. Scutellar sulcus with one median longitudinal carina. Median areola of propodeum with sharp margins. Anterior transverse carina of propodeum absent. Lateral longitudinal carinae of median tergite 1 sharp. Median syntergite 2+3 1.5 times longer than wide. Ovipositor about same length as body.

Biology. Reared 18 times from 3 species of *Antaeotricha* (Depressariidae) leaf-webbers feeding on mature leaves of five species of broad-leafed monocots (Hylaeanthe, Renealmia, Hedychium, Pleiostachya, Calathea) in the Marantaceae and Zingiberaceae in ACG rain forest 96 to 575 m.

Etymology. *Lytopylus okchunae* is named in honor of Okchun Kim, grandmother of the first author.

Material examined and distribution. Holotype ♀: Costa Rica, Alajuela, Sector Rincon Rain Forest, Palomo, Area de Conservación Guanacaste 10.96187N -85.28045W 96m., Cirilo Umaña coll., food plant: Marantaceae *Pleiostachya leiostachya*, host caterpillar: Depressariidae, Stenomatinae, *Antaeotricha* Janzen224, coll. date: 2/20/2012 parasitoid eclosion date: 3/4/2012, DHJPAR0050369 12-SRNP-67297.

Paratypes: [the following have the same data as the holotype except as indicated] ♀, Sendero Anonas, 10.90528N -85.27882W 405m., Jose Perez coll., food plant: Marantaceae *Hylaeanthe hoffmannii*, host caterpillar: *Antaeotricha* Janzen78, coll. date: 12/9/2010 parasitoid eclosion date: 1/2/2011, DHJPAR0041164 10-SRNP-44669. ♂, Anabelle Cordoba coll., food plant: Zingiberaceae *Renealmia cernua*, host caterpillar: *Antaeotricha* Janzen727, coll. date: 12/4/2012, parasitoid eclosion date: 12/23/2012,

DHJPAR0051363 12-SRNP-86993. ♀, Quebrada Bambu, 10.9301N -85.25205W 109m., Cirilo Umaña coll. food plant: *Hylaeanthe hoffmannii*, host caterpillar: *Antaeotricha* Janzen78, coll. date: 10/29/2012, parasitoid eclosion date: 11/16/2012, DHJPAR0050939 12-SRNP-77482. [same as previous except coll. date and eclosion date] ♀, coll. date: 2/14/2013, parasitoid eclosion date: 3/24/2013, DHJPAR0051910 13-SRNP-75544. ♂, coll. date: 12/30/2014, parasitoid eclosion date: 1/16/2015, DHJPAR0057424 14-SRNP-77730. ♂, coll. date: 12/30/2014, parasitoid eclosion date: 1/14/2015, DHJPAR0056977 14-SRNP-77732. ♀, coll. date: 1/6/2015, parasitoid eclosion date: 1/20/2015, DHJPAR0056982 15-SRNP-75048. ♀, coll. date: 1/6/2015, parasitoid eclosion date: 1/20/2015, DHJPAR0056980 15-SRNP-75049. ♂, Finca Esmeralda, 10.93548N -85.25314W 123m., Cirilo Umaña coll., food plant: *Hylaeanthe hoffmannii*, host caterpillar: *Antaeotricha* Janzen78, coll. date: 1/6/2015, parasitoid eclosion date: 1/18/2015, DHJPAR0056981 15-SRNP-75050. ♀, Sector San Cristobal, Sendero Colegio, 10.89296N -85.3788W 520m., Carolina Cano coll. food plant: *Hylaeanthe hoffmannii*, host caterpillar: *Antaeotricha* Janzen78, coll. date: 9/30/2009, parasitoid eclosion date: 10/12/2009, DHJPAR0037191 09-SRNP-5007. ♀, Estacion San Gerardo, 10.88009N -85.38887W 575m., Gloria Sihezar coll. food plant: Zingiberaceae *Hedychium coronarium* (introduced), host caterpillar: *Antaeotricha* Janzen727, coll. date: 5/1/2014, parasitoid eclosion date: 5/16/2014, DHJPAR0055345 14-SRNP-2296. [same as previous except coll. date and eclosion date] ♀, coll. date: 5/1/2014, parasitoid eclosion date: 5/17/2014, DHJPAR0055355 14-SRNP-2299. ♀, coll. date: 5/1/2014, parasitoid eclosion date: 5/19/2014, DHJPAR0055984 14-SRNP-2300. ♀, Rio Blanco Abajo, 10.90037N -85.37254W 500m., Gloria Sihezar coll., food plant: Zingiberaceae *Hedychium coronarium* (introduced), host caterpillar: *Antaeotricha* Janzen727, coll. date: 5/9/2014, parasitoid eclosion date: 6/1/2014, DHJPAR0055819 14-SRNP-2427. ♀, Guanacaste, Sector Pitilla, Pasmompa, 11.01926N -85.40997W 440m., Manuel Rios coll., food plant: *Calathea marantifolia*, host caterpillar: *Antaeotricha* Janzen78, coll. date: 12/1/2005, parasitoid eclosion date: 12/16/2005, DHJPAR0015529 05-SRNP-70149.

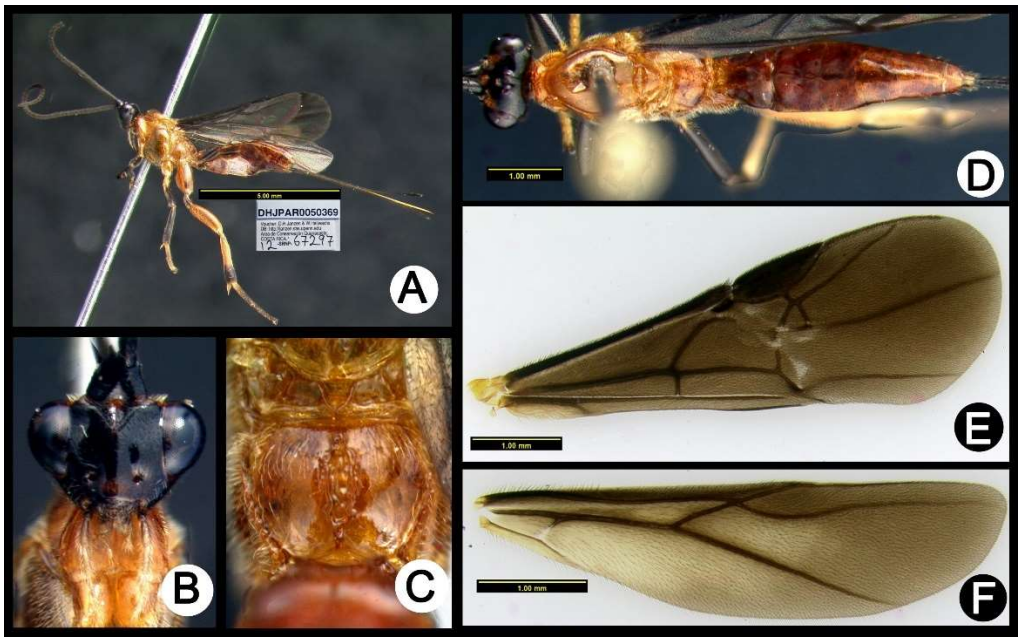


Plate 25. *Lytopylus okchunae* holotype: A. lateral habitus, B. anterior head, C. propodeum, D. dorsal habitus, E. fore wing, F. hind wing.

***Lytopylus pablocobbi* Kang n. sp.**

Diagnosis. Vertex of head entirely melanic; fore wing mostly infuscated; pronotum mostly orange, anteriorly black; mesoscutum entirely orange; anterior transverse carina of propodeum absent; median tergites entirely pale (yellow to orange); median syntergite 2+3 1.1 times longer than wide.

Description. Holotype: female. Body length 4.8 mm. Fore wing length 5.0 mm. Fore wing mostly infuscated. Pronotum bicolored. Scutellar sulcus with one median longitudinal carina. Median areola of propodeum with sharp margins. Anterior transverse carina of propodeum absent. Lateral longitudinal carinae of median tergite 1 sharp. Median syntergite 2+3 1.1 times longer than wide. Ovipositor longer than metasoma, but shorter than body.

Biology. Reared one time from elachJanzen01 Janzen640 (Depressariidae), a stenomine leaf-tier feeding on mature foliage of *Bunchosia odorata* (Malpighiaceae) in ACG dry forest – rain forest ecotone at 722 m.

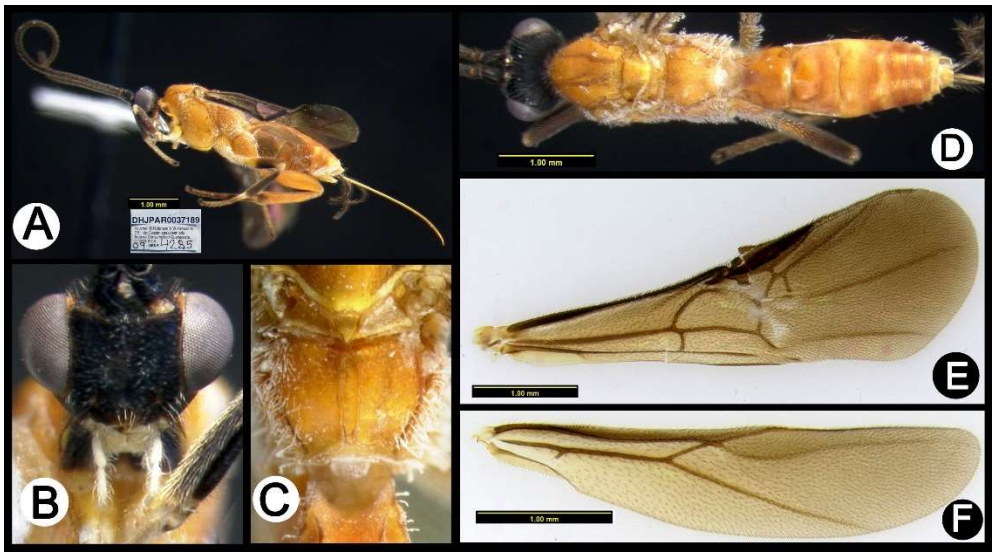


Plate 26. *Lytopylus pablocobbi* holotype: A. lateral habitus, B. anterior head, C. propodeum, D. dorsal habitus, E. fore wing, F. hind wing.

Etymology. *Lytopylus pablocobbi* is named in honor of Pablo Cobb in recognition of his participation in the collaborative development of the ICE-ACG geothermal project of Pailas II, north-western Costa Rica.

Material examined and distribution. Holotype ♀: Costa Rica, Alajuela, Sector San Cristobal, Jardin Estrada, Area de Conservación Guanacaste 10.86546N -85.39694W 722m., Gloria Sihezar coll., food plant: Malpighiaceae *Bunchosia odorata*, host caterpillar: Depressariidae, Stenomatinae, elachJanzen01 Janzen640, coll. date: 8/19/2009, parasitoid eclosion date: 9/16/2009, DHJPAR0037189 09-SRNP-4285.

***Lytopylus randallacunai* Kang n. sp.**

Diagnosis. Fore wing mostly infuscated; mesoscutum entirely melanic; median areola of propodeum lacking sharp margins; anterior transverse carina of propodeum absent; median tergites entirely reddish orange; lateral longitudinal carinae of median tergite 1 blunt.

Description. Holotype: female. Body length 5.8 mm. Fore wing length 5.6 mm. Fore wing mostly infuscated. Scutellar sulcus with three longitudinal carinae. Median areola of propodeum lacking sharp margins. Anterior transverse carina of propodeum absent.

Lateral longitudinal carinae of median tergite 1 blunt. Median syntergite 2+3 as long as wide. Ovipositor length longer than metasoma, but shorter than body.

Biology. Reared 2 times from *Anacampsis* Janzen353 (Anacampsinae, Gelechiidae) feeding on two species of Rutaceae in ACG dry forest – rain forest ecotone at 280 to 825 m.

Etymology. *Lytopylus randallacunai* is named in honor of Randall Acuña in recognition of his participation in the collaborative development of the ICE-ACG geothermal project of Pailas II, north-western Costa Rica.

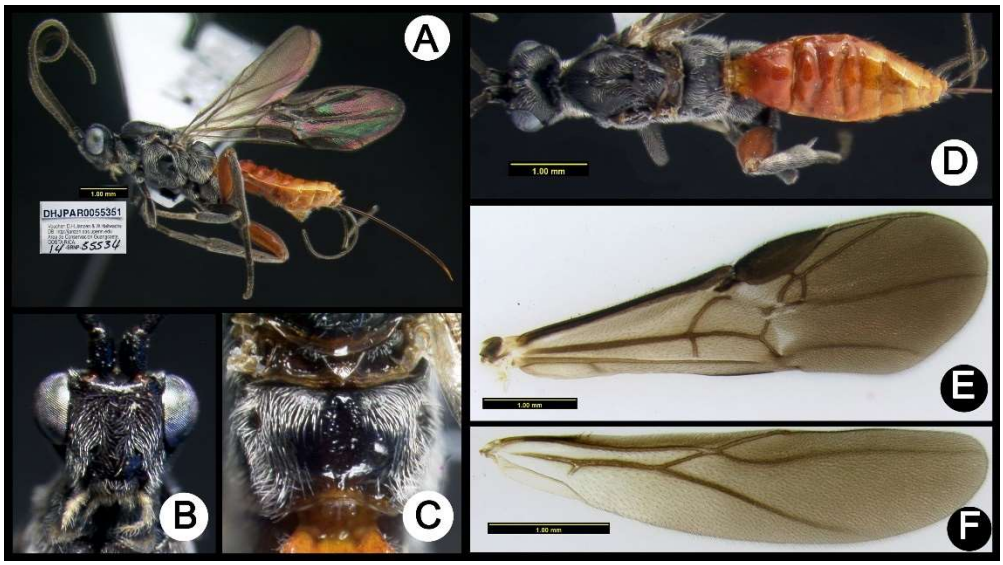


Plate 27. *Lytopylus randallacunai* holotype: A. lateral habitus, B. anterior head, C. propodeum, D. dorsal habitus, E. fore wing, F. hind wing.

Material examined and distribution. Holotype ♀: Costa Rica, Guanacaste, Sector Pailas, PL12, Area de Conservación Guanacaste 10.76248N -85.33689W 752m., Jose Cortez coll., food plant: Rutaceae *Zanthoxylum acuminatum*, host caterpillar: Gelechiidae, Anacampsinae, *Anacampsis* Janzen353, coll. date: 3/6/2014, parasitoid eclosion date: 4/9/2014, DHJPAR0055351 14-SRNP-55534.

Paratype: [the following have the same data as the holotype except as indicated] ♀, Sector Del Oro, Puente Mena, 11.04562N -85.45742W 280m., Lucia Ríos coll., food

plant: *Amyris pinnata*, coll. date: 4/1/2002, parasitoid eclosion date: 4/15/2002, DHJPAR0015430 02-SRNP-14223.

***Lytopylus robertofernandezi* Kang n. sp.**

Diagnosis. Fore wing with two black bands; pronotum entirely black; lateral longitudinal carinae of median tergite 1 blunt.

Description. Holotype: male. Body length 7.6 mm. Fore wing length 6.7 mm. Fore wing with two black bands. Scutellar sulcus with two longitudinal carinae. Anterior transverse carina of propodeum absent. Median areola of propodeum lacking sharp margins. Lateral longitudinal carinae of median tergite 1 blunt. Median syntergite 2+3 1.6 times longer than wide.

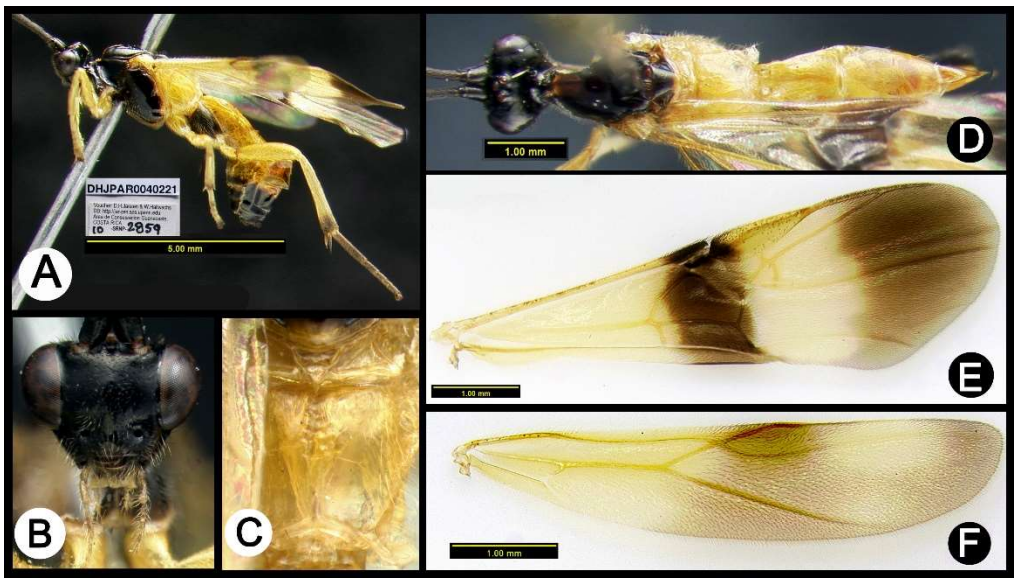


Plate 28. *Lytopylus robertofernandezi* holotype: A. lateral habitus, B. anterior head, C. propodeum, D. dorsal habitus, E. fore wing, F. hind wing.

Biology. Reared only 1 time and from the leaf-tier *Stenoma* Janzen687 (Depressariidae) feeding on mature leaves of *Pouteria exfoliata* (Sapotaceae) at the intersection of the ACG dry forest and rain forest ecosystems at 540 m elevation.

Etymology. *Lytopylus robertofernandezi* is named in honor of Roberto Fernandez in recognition of his participation in the collaborative development of the ICE-ACG geothermal project of Pailas II, north-western Costa Rica.

Material examined and distribution. Holotype ♂: Costa Rica, Alajuela, Sector San Cristobal, Tajo Angeles, Area de Conservación Guanacaste 10.86472N -85.41531W 540m., Carolina Cano coll., food plant: Sapotaceae *Pouteria exfoliata*, host caterpillar: Depressariidae, Stenomatinae, *Stenoma* Janzen687, coll. date: 6/7/2010, parasitoid eclosion date: 6/23/2010, DHJPAR0040221 10-SRNP-2859.

***Lytopylus rogerblancoi* Kang n. sp.**

Diagnosis. Fore wing mostly infuscated; mesoscutum entirely black; median areola of propodeum with sharp margins; anterior transverse carina of propodeum absent; median tergites entirely orange; lateral longitudinal carinae of median tergite 1 blunt.

Description. Holotype: female. Body length 6.0 mm. Fore wing length 6.4 mm. Fore wing mostly infuscated. Scutellar sulcus with three longitudinal carinae. Median areola of propodeum with sharp margins. Anterior transverse carina of propodeum absent. Lateral longitudinal carinae of median tergite 1 blunt. Ovipositor longer than metasoma, but shorter than body. Median syntergite 2+3 0.9 times longer than wide.

Biology. Reared 8 times, 1 time from a waif pupa and 7 times from gelJanzen01 Janzen356 (Dichomeridinae, Gelechiidae) feeding on mature leaves of *Hampea* and *Mortoniodendron* (Malvaceae) in ACG rainforest at 600-1180 m.

Etymology. *Lytopylus rogerblancoi* is named in honor of Roger Blanco in recognition of his participation in the collaborative development of the ICE-ACG geothermal project of Pailas II, north-western Costa Rica.

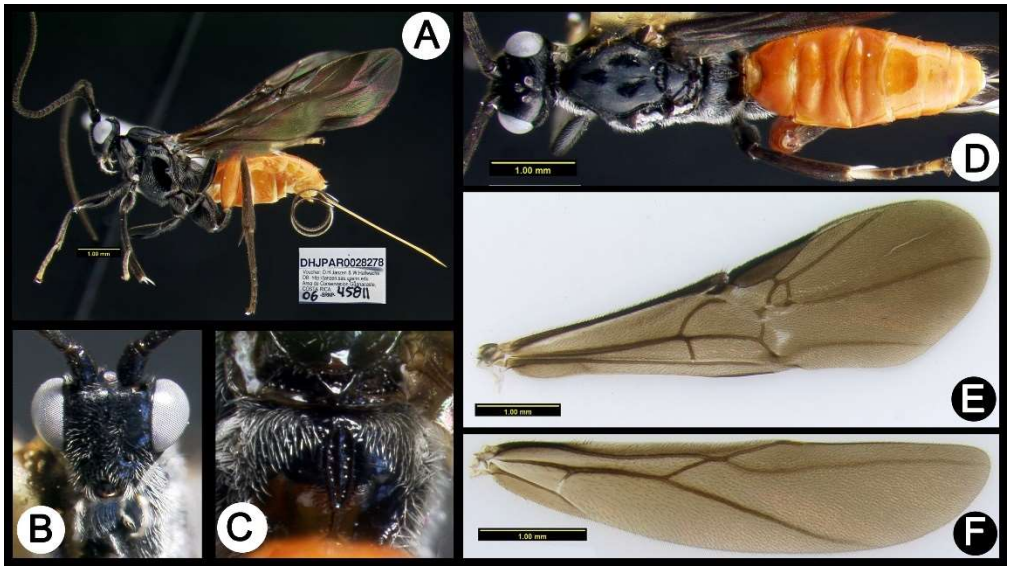


Plate 29. *Lytopylus rogerblancoi* holotype: A. lateral habitus, B. anterior head, C. propodeum, D. dorsal habitus, E. fore wing, F. hind wing.

Material examined and distribution. Holotype ♀: Costa Rica, Alajuela, Sector San Cristobal, Finca San Gabriel, Area de Conservación Guanacaste 10.87766N -85.39343W 645m., Carolina Cano coll., food plant: Malvaceae *Mortoniodendron costaricense*, host caterpillar: Gelechiidae, Dichomeridinae, gelJanzen01 Janzen356, coll. date: 1/28/2010, parasitoid eclosion date: 2/25/2010, DHJPAR0038905 10-SRNP-632.

Paratypes: [the following have the same data as the holotype except as indicated] ♀, coll. date: 11/30/2012, parasitoid eclosion date: 1/1/2013, DHJPAR0051361 12-SRNP-5323. ♂, coll. date: 2/21/2013, parasitoid eclosion date: 3/18/2013, DHJPAR0051914 13-SRNP-826. ♂, Jardin Estrada, 10.86546N -85.39694W 722m., Gloria Sihezar coll., coll. date: 12/10/2013, parasitoid eclosion date: 1/14/2014, DHJPAR0054536 13-SRNP-7159. ♂, Guanacaste, Sendero Segundo, 10.92679N -85.45332W 1180m., Manuel Pereira coll., food plant: Malvaceae *Hampea appendiculate*, coll. date: 7/30/2007, parasitoid eclosion date: 8/24/2007, DHJPAR0028281 07-SRNP-36305. ♂, Guanacaste, Sector Santa Maria, Sendero Canal, 10.76544N -85.28539W 799m., Mariano Pereira coll., food plant: Malvaceae *Mortoniodendron guatemalense*, coll. date: 7/23/2009, parasitoid eclosion date: 8/10/2009, DHJPAR0036354 09-SRNP-57036. ♀, Guanacaste, Sector Cacao, Gongora Bananal, 10.88919N -85.47609W 600m., Dunia Garcia coll., food plant

unknown, host caterpillar: Gelechiidae, Dichomeridinae, species unknown, coll. date: 6/29/2006, parasitoid eclosion date: 7/24/2006, DHJPAR0028278 06-SRNP-45811.

***Lytopylus salvadorlopezi* Kang n. sp.**

Diagnosis. Scutellar sulcus lacking longitudinal carina; fore wing mostly infuscated; anterior transverse carina of propodeum not reaching the lateral margin; median tergites mostly black.

Description. Holotype: female. Body length 7.5 mm. Fore wing length 7.3 mm. Fore wing mostly infuscated. Scutellar sulcus lacking longitudinal carina. Median areola of propodeum with sharp margins. Anterior transverse carina of propodeum not reaching the lateral margin. Lateral longitudinal carinae of median tergite 1 sharp. Median syntergite 2+3 1.2 times longer than wide. Ovipositor length about same length as body.

Biology. Reared five times from two species of leaf-tying *Stenoma* (Depressariidae) feeding on *Persea schiedeana* (Lauraceae) in ACG in the rain forest rain forest at 700 m.

Etymology. *Lytopylus salvadorlopezi* is named in honor of Salvador Lopez in recognition of his participation in the collaborative development of the ICE-ACG geothermal project of Pailas II, north-western Costa Rica.

Material examined and distribution. Holotype ♀: Costa Rica, Alajuela, Sector San Cristobal, Quebrada Cementerio, Area de Conservación Guanacaste 10.87124N - 85.38749W 700m., Osvaldo Espinoza coll., food plant: Lauraceae *Persea schiedeana*, host caterpillar: Depressariidae, Stenomatinae, *Stenoma* Janzen06, coll. date: 7/6/2009, parasitoid eclosion date: 8/6/2009, DHJPAR0036355 09-SRNP-3453.

Paratypes: [the following have the same data as the holotype except as indicated] ♀, parasitoid eclosion date: 8/15/2009, DHJPAR0036345 09-SRNP-3469. ♀, host caterpillar: *Stenoma* Janzen12, coll. date: 11/19/2009, parasitoid eclosion date: 12/18/2009, DHJPAR0037949 09-SRNP-6114.

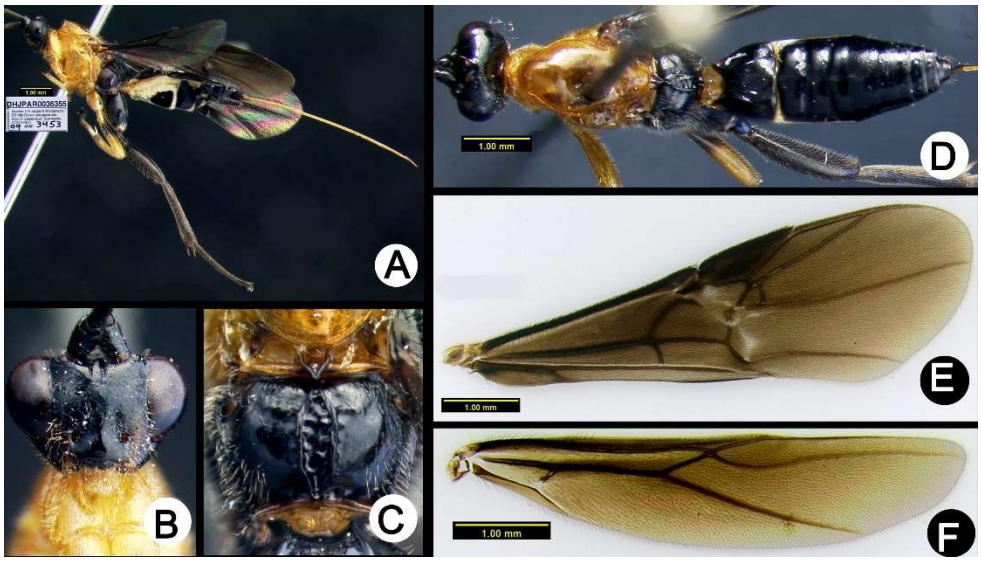


Plate 30. *Lytopylus salvadorlopezi* holotype: A. lateral habitus, B. anterior head, C. propodeum, D. dorsal habitus, E. fore wing, F. hind wing.

***Lytopylus sangyeoni* Kang n. sp.**

Diagnosis. Fore wing mostly infuscated; hind coxa entirely pale; mesoscutum entirely black; scutellar sulcus with one median longitudinal carina; anterior transverse carina of propodeum reaching the lateral margin; median tergites mostly pale with posterior terga black; median syntergite 2+3 as long as wide.

Description. Holotype: female. Body length 5.5 mm. Fore wing length 5.3 mm. Fore wing mostly infuscated. Scutellar sulcus with one median longitudinal carina. Median areola of propodeum with sharp margins. Anterior transverse carina of propodeum reaching the lateral margin. Lateral longitudinal carinae of median tergite 1 sharp. Median syntergite 2+3 as long as wide. Ovipositor longer than metasoma, but shorter than body.

Biology. Reared 1 time from elachJanzen01 Janzen847 (Depressariidae) as a leaf-tier feeding on mature leaves of *Senegalia tenuifolia* (Fabaceae) in ACG rain forest at 527 m.

Etymology. Named in honor of Sangyeon Park, father-in-law of the first author.

Material examined and distribution. Holotype ♀: Costa Rica, Alajuela, Sector San Cristobal, Sendero Huerta, Area de Conservación Guanacaste 10.9305N -85.37223W 527m., Carolina Cano coll., food plant: Fabaceae *Senegalia tenuifolia*, host caterpillar: Depressariidae, subfamily unknown, elachJanzen01 Janzen847, coll. date: 11/4/2011, parasitoid eclosion date: 11/21/2011, DHJPAR0046955 11-SRNP-4285.

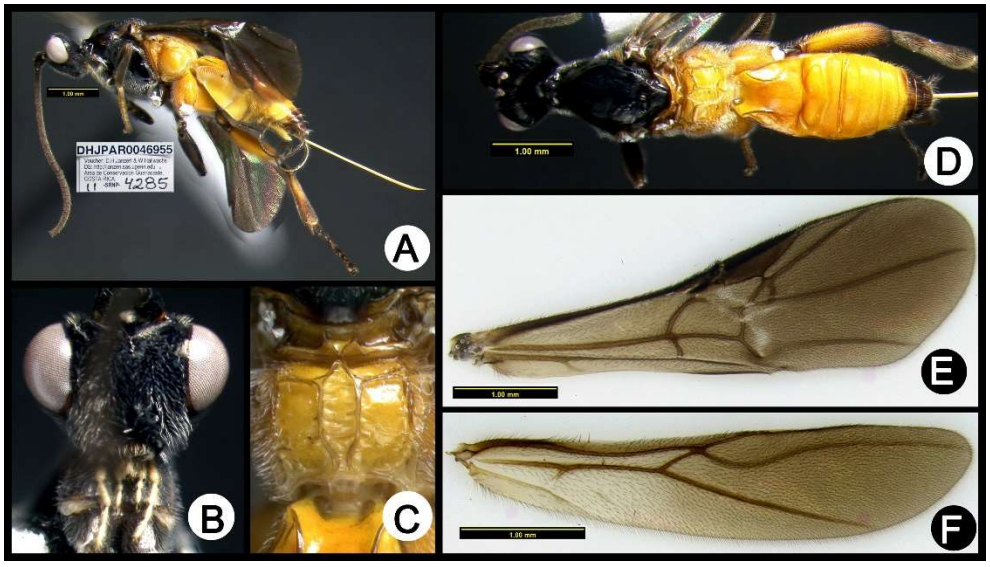


Plate 31. *Lytopylus sangyeoni* holotype: A. lateral habitus, B. anterior head, C. propodeum, D. dorsal habitus, E. fore wing, F. hind wing.

***Lytopylus sarahmeierottoae* Kang n. sp.**

Diagnosis. Fore wing mostly infuscated; pronotum entirely pale; mesoscutum entirely pale; scutellar sulcus lacking longitudinal carina; anterior transverse carina of propodeum reaching the lateral margin; median tergites mostly melanic, anteriorly white.

Description. Holotype: female. Body length 5.1 mm. Fore wing length 4.8 mm. Fore wing mostly infuscated. Scutellar sulcus lacking longitudinal carina. Median areola of propodeum with sharp margins. Anterior transverse carina of propodeum reaching the lateral margin. Lateral longitudinal carinae of median tergite 1 sharp. Median syntergite 2+3 as long as wide. Ovipositor slightly longer than body.

Biology. Reared 4 times from *Cerconota* Janzen82 (Stenomatinae, Depressariidae) feeding on mature leaves of *Inga micheliana* (Fabaceae) in ACG rain forest at 730 m.

Etymology. Named in honor of Sarah Meierotto, graduate student in the Department of Entomology at the University of Kentucky, for her assistance.

Material examined and distribution. Holotype ♀: Costa Rica, Alajuela, Sector San Cristobal, Sendero Vivero, Area de Conservación Guanacaste 10.86739N -85.38744W 730m., Elda Araya coll., food plant: Fabaceae *Inga micheliana*, host caterpillar: Depressariidae, Stenomatinae, *Cerconota* Janzen82, coll. date: 12/20/2014, parasitoid eclosion date: 1/13/2015, DHJPAR0056993 14-SRNP-5529.

Paratypes: [the following have the same data as the holotype except as indicated] 2♀, parasitoid eclosion date: 1/10/2015, DHJPAR0056984 14-SRNP-5525, DHJPAR0056991 14-SRNP-5528. ♀, parasitoid eclosion date: 1/17/2015, DHJPAR0056992 14-SRNP-5517.

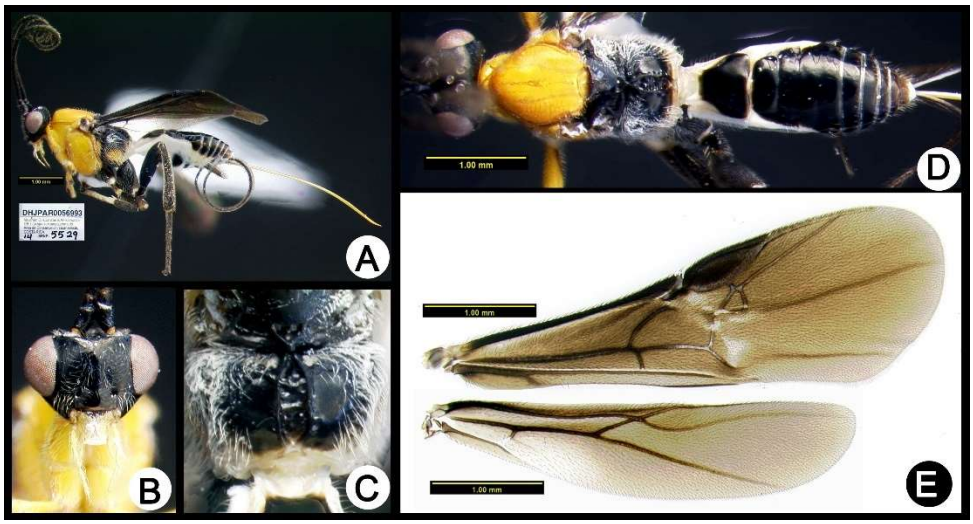


Plate 32. Lytopylus sarahmeierottoae holotype: A. lateral habitus, B. anterior head, C. propodeum, D. dorsal habitus, E. wings.

***Lytopylus sergiobermudezi* Kang n. sp.**

Diagnosis. Fore wing hyaline; fore wing RS+Ma 80% complete; anterior transverse carina of propodeum reaching the lateral margin; median tergites mostly pale with posterior terga black.

Description. Holotype: male. Body length 3.9 mm. Fore wing length 3.6 mm. Fore wing hyaline. Fore wing RS+Ma more complete. Scutellar sulcus with four longitudinal carinae. Median areola of propodeum with sharp margins. Anterior transverse carina of propodeum reaching the lateral margin. Lateral longitudinal carinae of median tergite 1 sharp. Median syntergite 2+3 1.1 times longer than wide.

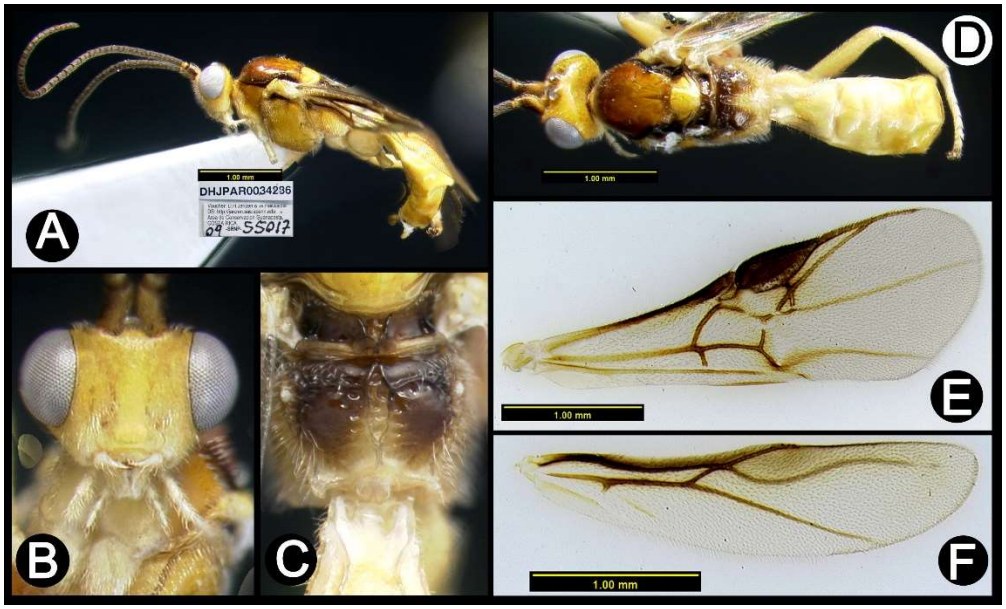


Plate 33. *Lytopylus sergiobermudezi* holotype: A. lateral habitus, B. anterior head, C. propodeum, D. dorsal habitus, E. fore wing, F. hind wing.

Biology. Reared 2 times from *Dichomerus santarosensis* (Dichomeridinae, Gelechiidae) leaf-tier feeding on new foliage of *Quercus oleioides* (Fagaceae) en ACG dry forest at 420 m.

Etymology. *Lytopylus sergiobermudezi* is named in honor of Sergio Bermudez in recognition of his participation in the collaborative development of the ICE-ACG geothermal project of Pailas II, north-western Costa Rica.

Material examined and distribution. Holotype ♂: Costa Rica, Guanacaste, Sector Mundo Nuevo, Punta Plancha, Area de Conservación Guanacaste 10.7416N -85.42734W 420m., Mariano Pereira coll., food plant: Fagaceae *Quercus oleoides*, host caterpillar: Gelechiidae, Dichomeridinae, *Dichomeris santarosensis*, coll. date: 1/5/2009, parasitoid eclosion date: 1/19/2009, DHJPAR0034286 09-SRNP-55017.

Paratype: [the following have the same data as the holotype except as indicated] ♂, DHJPAR0030601 09-SRNP-55018.

***Lytopylus sigifredomarini* Kang n. sp.**

Diagnosis. Fore wing mostly infuscated; hind coxa entirely pale; mesoscutum entirely black; scutellar sulcus lacking longitudinal carina; anterior transverse carina of propodeum reaching the lateral margin.

Description. Holotype: male. Body length 5.2 mm. Fore wing length 4.8 mm. Fore wing mostly infuscated. Scutellar sulcus lacking longitudinal carina. Median areola of propodeum with sharp margins. Anterior transverse carina of propodeum reaching the lateral margin. Lateral longitudinal carinae of median tergite 1 sharp. Median syntergite 2+3 1.2 times longer than wide.

Biology. Reared 3 times from *Antaeotricha* Janzen224 (Stenomatinae, Depressariidae) feeding on mature leaves of *Hirtella media* (Chrysobalanaceae) in ACG rain forest at 410 to 620 m.

Etymology. *Lytopylus sigifredomarini* is named in honor of Sigifredo Marin in recognition of his participation in the collaborative development of the ICE-ACG geothermal project of Pailas II, north-western Costa Rica.

Material examined and distribution. Holotype ♂: Costa Rica, Guanacaste, Sector Del Oro, Tangelo, Area de Conservación Guanacaste 11.01823N -85.45024W 410m., Elieth Cantillano coll., food plant: Chrysobalanaceae *Hirtella triandra*, host caterpillar:

Depressariidae, Stenomatinae, *Antaeotricha* Janzen224, coll. date: 1/6/2011, parasitoid eclosion date: 1/31/2011, DHJPAR0042545 11-SRNP-20067.

Paratypes: [the following have the same data as the holotype except as indicated] ♂, Bosque Aguirre, 11.0006N -85.438W 620m., Roster Moraga coll., coll. date: 5/7/2010, parasitoid eclosion date: 5/31/2010, DHJPAR0040328 10-SRNP-20701. ♂, Sector Pitilla, Coneja, 11.01525N -85.39766W 415m., Dinia Martinez coll., food plant: *Hirtella media*, coll. date: 5/6/2013, parasitoid eclosion date: 5/27/2013, DHJPAR0052899 13-SRNP-70762.

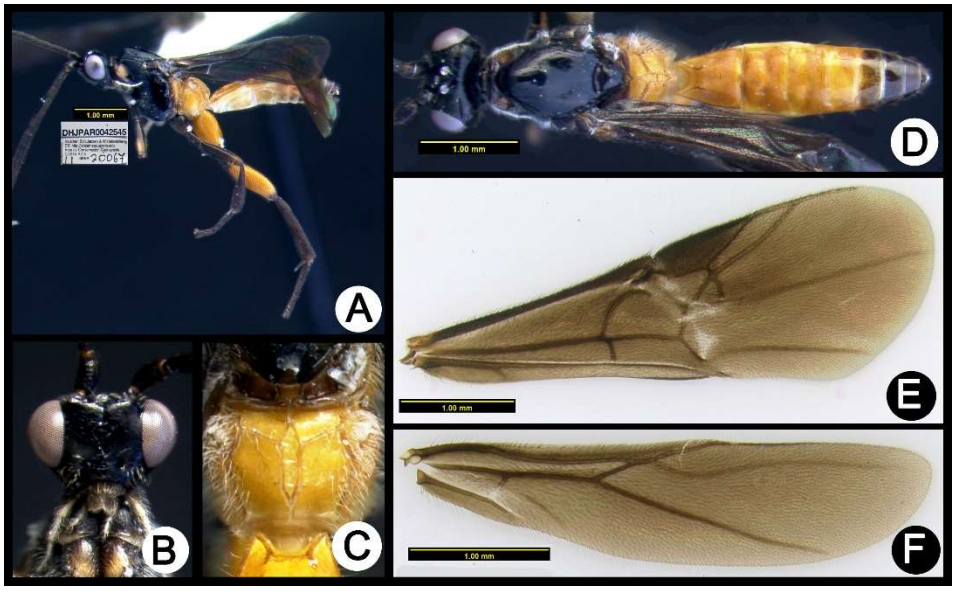


Plate 34. *Lytopylus sigifredomarini* holotype: A. lateral habitus, B. anterior head, C. propodeum, D. dorsal habitus, E. fore wing, F. hind wing.

***Lytopylus youngcheae* Kang n. sp.**

Diagnosis. Fore wing with one black band; vertex of head entirely melanic.

Description. Holotype: female. Body length 8.9 mm. Fore wing length 8.1 mm. Fore wing with one black band. Scutellar sulcus with one median longitudinal carina. Anterior transverse carina of propodeum not reaching the lateral margin. Median areola of propodeum with sharp margins. Lateral longitudinal carinae of median tergite 1 sharp. Median syntergite 2+3 1.5 times longer than wide. Ovipositor slightly longer than body.

Biology. Reared 5 times from two species of stenomatine Depressariidae leaf-tiers feeding on mature leaves of *Calophyllum brasiliense* (Calophyllaceae) in ACG rain forest at 540-740 m elevation.

Etymology. Named in honor of Youngche Choi, mother of the first author.

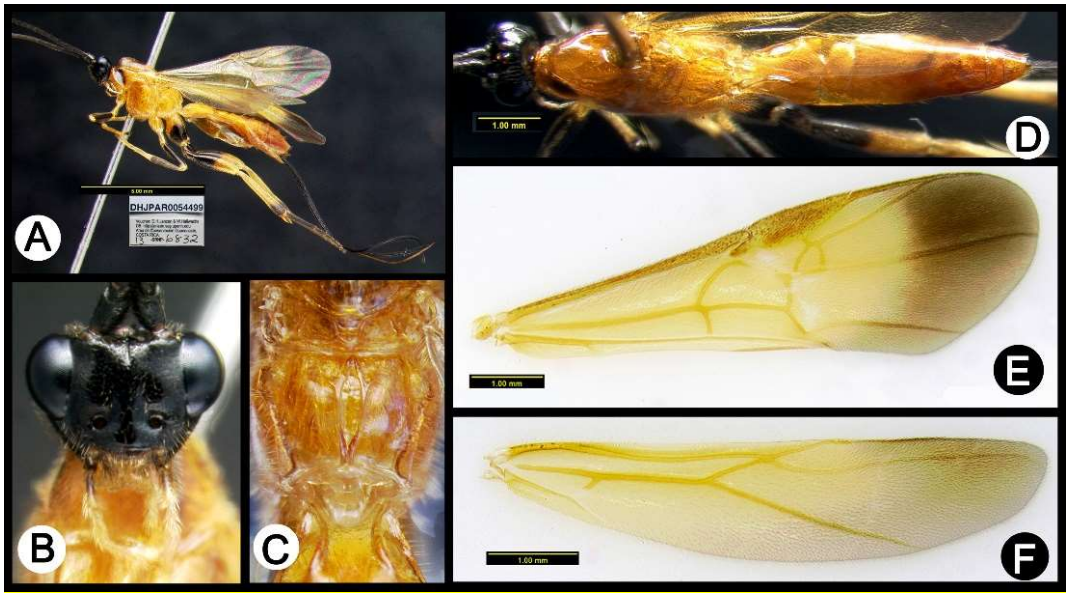


Plate 35. *Lytopylus youngcheae* holotype: A. lateral habitus, B. anterior head, C. propodeum, D. dorsal habitus, E. fore wing, F. hind wing.

Material examined and distribution. Holotype ♀: Costa Rica, Alajuela, Sector San Cristobal, Cementerio Viejo, Area de Conservación Guanacaste 10.88111N -85.38889W 570m., Carolina Cano coll., food plant: Calophyllaceae *Calophyllum brasiliense*, host caterpillar: Depressariidae, Stenomatinae, *Cerconota* Janzen140, coll. date: 11/27/2013, parasitoid eclosion date: 12/31/2013, DHJPAR0054499 13-SRNP-6832.

Paratypes: [the following have the same data as the holotype except as indicated] ♀, Guanacaste, Sector Pitilla, Sendero Memos, 10.98171N -85.42785W 740m., Elieth Cantillano coll., coll. date: 4/27/2007 parasitoid eclosion date: 5/27/2007, DHJPAR0021132 07-SRNP-32046. ♂, Finca San Gabriel, 10.87766N -85.39343W 645m., host caterpillar: *Antaeotricha* Janzen134, coll. date: 4/1/2013, parasitoid eclosion date: 4/30/2013, DHJPAR0052197 13-SRNP-1708. ♀, Tajo Angeles, 10.86472N -

85.41531W 540m., Elda Araya coll., host caterpillar: *Antaeotricha* Janzen134, coll. date: 12/31/2010, parasitoid eclosion date: 1/24/2011, DHJPAR0041586 10-SRNP-7479. [same as previous except as eclosion date] ♂, parasitoid eclosion date:1/25/2011, DHJPAR0041585 10-SRNP-7480.

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